LESSON PLANS FOR TEACHERS

in

Nature-Study Agriculture

BASED UPON THE ILLINOIS
STATE COURSE OF STUDY

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"And he wandered away, away with Nature the dear old nurse,
Who sang to him night and day the rhymes of the universe,
And when the day seemed long, and his heart began to fail,
She sang a more wonderful song, or told a more wonderful tale."

PREFACE

Two years ago when a course in Nature Study Agriculture became a part of the new state course of study there arose on the part of teachers a demand for some special help in teaching this subject. To supply this need the Lesson Plans in Nature Study Agriculture were published. That these have proved of value is very evident. Both teachers and superintendents speak in the highest terms of their usefulness.

The first edition is now exhausted and it seems wise to publish a second edition. The lessons have been carefully revised and a number that in the first edition were rather meager have been rewritten in full. The arrangement of the years has been changed to follow each other consecutively instead of previous plan of grouping into odd and even years. This will add to the efficiency of the book.

The lessons are planned expressly for busy teachers and especially for those who have had little or no training in nature study and elementary agriculture. They include how to obtain material, what to have the children observe, how to report the observations, how to conduct simple experiments, etc. At the same time sufficient information is given with each lesson to enable the teacher to gain the fundamental facts that she should know in order to present the lesson successfully.

RELATION TO THE CHILDREN.—The book presupposes that the work in the schools will be real nature study, that the children will handle and observe real objects, will perform experiments, will work with their hands and think while they work. This will bring them into the right relation with their environment so that the nature-world, their inheritance, shall become their own to understand and to love. This work will enable them also to see beauty and value in everyday common places especially as they put to the test some of the fundamental laws of life and of physical phenomena, or as they experience the joy that comes with beautifying their own school and home grounds.

RELATION TO THE TEACHER.—The teacher as well as the pupils is a learner in this work. No matter how much she may know about nature objects she realizes that there is still much to be learned. There is no "finis" written in the book of nature. Every day she finds new interest in the wayside plants, in every flying and crawling insect, in the birds, and trees, and in the farm and garden crops. Her life is enriched and broadened both by her own contact with the nature world and by her efforts to bring her pupils into a sympathetic understanding of this world.

RELATION TO PARENTS.—Since the nature study deals with the environment of the children it is a strong factor in keeping home and school in close touch with each other. The material used is the material of the home, the field and shop; parents are interested because the children come to them with questions or information about objects and phenomena that they constantly use in their daily work. The special days suggested by the course such as Harvest Festival, Corn Day and Arbor Day, afford an excellent opportunity to invite the parents to the school in order that they may see what the children are accomplishing in the work.

CORRELATION WITH OTHER SUBJECTS.—Many rural teachers find lack of time the principal obstacle to nature-study and agricultural work. The daily program is already full. Another subject may be the last straw. But with careful correlation we believe that the nature study lessons will make the other work more interesting and more effective. As the course is planned a part of the language work is based upon the nature-study topics. Much of the arithmetic may be correlated with the nature-study. This is also true of the drawing. In the first and second grades the constructive work offers excellent opportunity for correlation. Indeed, much of the constructive work may find its most interesting motivation in connection with the doll house, the barn, poultry yard, etc. The plan of correlation ought to make possible the working out of most of the course as outlined for the first six years.

AGRICULTURAL PHASE OF WORK.—The course is essentially agricultural in its material and aims because it deals with the birds and trees, with flowers and garden plants, with farm crops and animals, with soil and machinery, all of which have to do with agriculture. It does not pretend to go into the science of agriculture as high schools and colleges do, but it aims to make a good foundation for this more advanced work. It is good agriculture as far as it goes. It helps the boys and girls to appreciate the farm and its surroundings as nothing else can do, and at the same time becomes an important factor in promoting better methods of agriculture in our state.

PHYSIOLOGY.—The part of the course called physiology has for its chief aim the improvement of health conditions. The children should be led to form habits that make for good health, to become sensitive to unsanitary conditions, and feel some responsibility in making conditions better. It is only thru persistent effort and constant application of the principles learned that right habits will be formed.

ALICE JEAN PATTERSON.

Normal, Ill., May 24, 1914.

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LESSON PLANS FOR FIRST YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER.—(*To be used in September of odd numbered years, alternating with second year work. Two periods of each week devoted to actual contact with materials studied. The three periods of language to be closely correlated with the nature-study.*) *The home and who lives there. What does father do? Mother? Sisters? Brothers? How do you help? Rooms in the house; uses of each; furnishings. Make a doll house of pasteboard or box; cut furniture, rugs, utensils; preserve distinction of rooms. The school house; rooms, furniture, uses, care. Children assist in keeping room in order; learn use of damp cloth in cleaning; a place for everything. Other public places,—church, store, depot, town house, bank, factory; what is done in each?*

(Eighteen lessons planned. These need not be given in just the order used here.)

SUGGESTED SCHEDULE.—The Home, 2 lessons; The Doll's House, 5 lessons; The School and Other Public Places, 2 lessons; The Garden, 3 lessons; Birds, 2 lessons; Trees, 2 lessons; Poems, 2 lessons.

OUTDOOR VISITS.—In addition to the work outlined in the course, it is suggested that the pupils visit and identify a few common trees of the neighborhood, observe and name some of the common birds, visit a garden and compare it with that at home.

THE HOME.—Who lives at home? Who helps to make it comfortable and pleasant? What things does mother do? (Ideas of preparation of food, clothing, cleanliness, comfort, pleasure, helpfulness, will be brought out, each child being encouraged to contribute his share to the conversation.)

What is father's work? (Ideas of earning, of further contact with the outside world will be added.)

What do you children do at home? How do you help? How do you play? (In addition to accounts of daily tasks and pleasures, the idea of the necessity of co-operation and of service is brought out.)

These talks should do much to make the beginners feel "at home" in the strange environment—to make a unity of interest between home and school—and to encourage and preserve spontaneity and freedom of oral expression. In this connection pupils may learn the poem "I love you, mother," from Mrs. McMurry's "Treetop and Meadow," or they may learn and dramatize "This is the way we wash our clothes, etc."

THE DOLL'S HOUSE.—This follows easily the talks about the home. The playhouse may be made very simply—consisting of only one or two rooms—or more elaborately with "cellar" and "upstairs." In any case it may be made of a large pasteboard box with partitions, or of smaller boxes fastened in any desired arrangement with glue or paper fasteners. The entire front should be left open for easy access by the "owners." If preferred a wooden box may be used, with roof, partitions and window openings added by older pupils.

Furnishing should be made by the little people themselves and may be simple or more elaborate as time permits. Chairs, tables, beds and cupboards may be made from cardboard or folded from paper, which material can be obtained at a printing office. Worst's *Construction* is helpful in this connection. Rugs and matting may be woven from cord, rags, or raffia. Curtains may be cut from scraps of material brought from homes. Wallpaper may be made at school or furnished from scraps left from the home "housecleaning."

Part of this work may be done as seat work. Some, like the formal construction, must be done under the teacher's direction to secure worthy results and correct habits and ideals. Original, volunteer work should be encouraged, and surprising interest and results will follow.

The pupils should be held responsible for keeping this small dwelling in order, and through that work some valuable habits may be formed. They should learn to dust properly; to keep the playhouse and their own desks neat, orderly and free

from dust; to clean the blackboards without filling the air with chalk dust; to clean erasers out of doors instead of at the window, and the reason why; to clean mud from shoes before entering house, etc.

THE SCHOOLHOUSE.—The foregoing lessons prepare the way for some ideas of public institutions: Why do we have a schoolhouse? Who builds it? Who should help care for it? How can this be done? Some system of appointing monitors may prove helpful in promoting ideals and habits of helpful service.

OTHER PUBLIC PLACES.—Activities growing out of home and school interests will rapidly include a wider field, and the function of stores, depot, church, factory may be discussed. In such talks the ideas of interdependence and the spirit of service should be made prominent. Illustrations in free cutting or with pencil to represent the various places, together with roads and streets, will prove interesting.

THE GARDEN.—During this month a nearby garden should be visited if the school has none, and the vegetables and flowers recognized and named. Questions like these will reveal and recall facts of interest: What grows in your garden? Who planted and cared for it? What have you got from it? What things have helped the plants to grow? (Sun, rain, care, good soil.) What work has been done in the garden? Why? What things in it are not yet ready for use?

If possible, the children should have the pleasure of gathering flowers, both wild and cultivated, for school room decoration. They should be shown how to pick them with stems suitable for bouquets, and can be taught that most flowers look best if each kind is put in a vase by itself.

Vegetables and flowers may be cut and colored, or pictures cut from catalogs and pasted in scrap books.

BIRDS.—Opportunity should be found to observe whatever birds frequent the neighborhood—especially robins and blackbirds. What are they doing? Find out what they eat. Look for different foods birds can eat. What have the birds done in summer? Can you find any young birds? Pupils relate personal observation of bird life during summer. Keep a shallow pan filled with water where birds can find it. Use outline pictures of birds to color, or cut them free-hand.

TREES.—At least one visit to become more intimately acquainted with one or two familiar trees should be made this month. Find a tree whose name you know. Where are others like it? What about it helps you to remember it? Recall how it looked last winter. When did its leaves appear? Why do we like trees? Whom do they help besides people? (Nesting places for birds and squirrels, shade for animals, etc.)

Tear tree-pictures from paper and color them. Make borders of leaf shapes studied, as elm, maple, oak.

OCTOBER

OUTLINE FOR OCTOBER.—*Make a cardboard wall chart to show weather for each month. Make a blank calendar form and, on each school day, paste in a colored disc showing kind of day,—yellow for sunny, gray for cloudy, purple or blue for rainy, and sprinkled with diamond dust for snow. In margin make sketch appropriate to month. Children gradually learn days of week, character of month, names of seasons, holidays, birthdays, etc.*

What the garden contributes to our food. Visit garden to note autumn condition, harvesting; effect of frost. Collection and simple study of common vegetables which grow above ground; below ground; draw and color a few. How stored for winter? Provisions for food storage in doll house. Where we get vegetables when we have no garden; where the grocer obtains his supply; how he keeps them. Similarly, food we obtain from farm crops. From corn,—breakfast foods, corn meal, corn starch, hominy, popcorn. Identification and collection of samples. Similar study of wheat and oats products.

SUGGESTED SCHEDULE.—Calendar, 1 lesson; Garden, 5 lessons; Trees, 2 lessons; Birds, 2 lessons; Food Charts and Study, 4 lessons; Construction, 2 lessons; Poems, 2 lessons.

THE WEATHER.—A few moments each day devoted to a study of weather conditions will help to make the children's observations definite, and will give them more accurate knowledge of natural phenomena and their effects. The calendar form may be drawn upon the blackboard, or upon a large sheet of cardboard, and records made as suggested above. (Colored paper for this and many other school purposes may be obtained of Thomas Charles Co., Chicago, Ill.) If the blackboard is used colored crayon will serve. If the calendar is placed upon a north wall, the pupils can very early learn to use arrows to indicate the direction of the wind, which should be found by careful observation.

Pupils will greatly enjoy the poem, "October's Bright Blue Weather" in this connection.

THE GARDEN.—The object of the first visit should be to find and name all plants which contribute to our food supply. The children should tell how each is to be harvested, and if possible to be given an opportunity to share in the work. The effects of frost should be carefully noted. Try to see how long a list of vegetables can be made from actual acquaintance and contact. The names may be kept in two lists, to distinguish those which grow above and below ground. A visit to a well-stocked cellar (noting the various commodities which are stored, together with different methods of storing) will prove a valuable lesson. Pupils may then make boxes for doll house cellar, and fill them with real vegetables, or make imitation in clay. If the latter, they may be colored with ordinary water colors. If time permits it is well now to cut paper dolls or make some clay dolls to inhabit this finished dwelling.

Study of the world beyond home and school may continue by discussion of the grocer's stock, paying especial attention to those supplies which come from gardens like our own. Where does he get so many vegetables? Why and how does he keep them? Picture the farmer's wagon loaded with vegetables from the garden. The grocer's delivery wagon, which brings them to some who have no gardens.

Valuable information, gathered at first hand, can be gained concerning the seeds of the various vegetables. In many cases the problems must be left unsolved, but a wholesome attitude of inquiry will be secured which may often result in personal investigation by the small "scientists."

FOOD FROM THE FIELDS.—What foods do the farm fields give us? Corn, wheat, oats. Pupils should bring samples of various kinds of each grain, samples of products made from each, together with pictures illustrating the uses of each. Very interesting charts can be made showing all these facts. Manufactured products may be put in tiny bottles and fastened to the large cardboard sheet with cord, and the pictures may be pasted on.

Enough attention should be given to autumn flowers, both wild and cultivated, to see that pupils learn the names of a few common varieties; and that they are helped to appreciate their beauty both in and out of doors. Opportunity may be found for lessons in coloring and in tasteful arrangement,—the flower of the thistle, for example, makes a very pretty unit for decorating a border for a book-cover.

TREES.—In October the leaves begin to color and fall. Individual trees noted last month should be observed again. What changes can we find? Any further marks of recognition? Gather some twigs and see how easily the leaves may be shaken off. Look carefully at the place on the twig from which the leaf has dropped. What do you see?

Carefully gather and press brightly colored leaves for use indoors. Make a border of them along the top of the blackboard, pin them on sash-curtains, etc. Make a book and paste in all pretty kinds of leaves you know. Write the name of each neatly. Rake fallen leaves in home or school yard. Learn Stevenson's "Seasons."

BIRDS.—Which ones are here now? Which that you have seen are not here now? Why? What food can they find now? Where do birds stay at night? What troubles or dangers come to them at this season? Try to see which ones stay longest. Cut pictures of flocks flying south.

CONSTRUCTION WORK.—Sage and Cooley's OCCUPATIONS FOR LITTLE FINGERS is recommended as a guide for the construction work done in this month.

NOVEMBER

OUTLINE FOR NOVEMBER.—*Continue chart begun in October. Thanksgiving.*

Outdoor studies.—Note changes in trees, gardens, fields; in outdoor activities.

Foods from farm crops.—Collect samples of various forms made from corn, wheat, oats.

Doll's house.—Make more furniture, curtains, wall-paper, etc.

The pumpkin or the squash.—Its parts; how it is prepared for pies; how to save seeds.

Out-of-door work.—What birds can you see now? What do they eat? What has happened to the trees? How can you now recognize them? What is being done in the fields?

THE PUMPKIN.—Have a fine ripe pumpkin at school. Where have you seen pumpkins growing? What do we call the plant? How large is the vine? The leaf? The flower? Tell what you remember of the flower. Where are pumpkins often planted? Tell how pumpkins look when small. What helps them grow?

Why do we raise pumpkins? What animals eat them? How are they fed? How do we like pumpkins? How are they prepared for pie? What happens if they are left in the field until frost comes? How can we keep them for later use? How may people have pumpkin pie who cannot get fresh pumpkins?

What must we do for a crop next year? Let pupils remove seeds, dry them, and make envelopes in which to keep them all winter. When cut, notice skin, flesh, arrangement of seeds, coloring.

What fun may we have with pumpkins? On what night? Tell a Halloween story. What kind of pranks are good fun for everybody? How can we make a Jacko'lantern? If class is not too large, let the children make one, all working together, at seat-work period. Or, each pupil may make one of clay, coloring when dry.

Paint pumpkins for drawing lessons. Add eyes, etc., to make a "face."

Bring a squash to school. Compare with pumpkin as to shape, size, color, hardness, place and method of growth, use, "keeping" qualities, manner of cooking. Save seeds. How distinguish them from pumpkin seeds?

Paint a squash and a pumpkin to note differences. Cut them from paper.

THANKSGIVING.—What holiday comes this month? Why do we have Thanksgiving? Various answers will be given, by the pupils, chiefly concerning the Thanksgiving dinner. These provide a point of departure for some review of their knowledge of garden products. Name the things we may have for Thanksgiving dinner which grow in the gardens or fields. Which of these come from our own farms? Which are grown in far-away places?

Tell the story of the Pilgrims' Thanksgiving. If a program is given this story may be simply dramatized.

Let the pupils mold, in clay, fruits and vegetables for the Thanksgiving dinner table, keeping proportion in size. Color them, if convenient. Set the table in the doll's house.

Mention all the kinds of food that are made from corn. From wheat. From oats. How are the different ones prepared? How are they cooked? Bring samples for the doll's house. Make such furnishings for the doll's house as are needed for storing food, *i. e.*, cupboards, boxes, etc.

DECEMBER

OUTLINE FOR DECEMBER.—*The Weather—Changes since opening of fall term. Length of days, position of sun. Effect of cold upon home activities, school sports.*

How we keep warm in winter. Clothing—kinds, how distinguish each? Make collections of pieces of cotton, woolen and silk cloths. Sources of material for clothing. Describe a visit to a dry goods store. Who buys our clothes, who makes them. Clothing of primitive people. Care of our clothing.

How we keep warm in winter. Clothing—kinds, how distinguish each? Make collections of pieces of cotton, woolen and silk cloths. Sources of material for

clothing. Describe a visit to a dry goods store. Who buys our clothes, who makes them. Clothing of primitive people. Care of our clothing.

Christmas tree. Simple study of evergreen. Make trimmings and gifts for a Christmas tree in the doll's house.

THE SEASON.—What season have we now? Name all the signs of winter that you can. Short days, cold weather, snow, ice, frozen earth, leafless trees, brown grass. What birds are gone? Which are here? Put out food and learn if they eat it. Fasten some suet in a tree where you can watch it, and see if the birds eat it.

Do you get up in time to see the sun rise? Where does it rise? At what time? When and where does it set?

What difference does the cold weather make in our work? In our play? To the farm animals?

CLOTHING.—What difference does winter make in our clothing? Of what is our warm clothing made? Where does cotton grow? From where do we get wool? Identify cotton and woolen materials among children's garments. Have samples of each brought to class. Note use of fur, also.

Too heavy clothing should not be worn in a warm room. Comfortable wraps are necessary out of doors. Too heavy wraps should not be worn when we are playing actively. We should not sit with wet clothing on. How can children *try* to avoid having wet feet?

Pupils should be taught to keep wraps carefully hung up, to keep their rubbers in proper places, to clean their shoes before entering the school house, to avoid unnecessary soiling of the clothing while at school.

A discussion of the kinds and sources of the clothing of Indians, Eskimos, and other primitive peoples, will give a basis for a practical discussion of the need of keeping the clothing and the body clean, and will aid in establishing hygienic habits.

CHRISTMAS.—What do we do to make Christmas a pleasant time? What trees do we use for Christmas trees? Why? Where have you seen evergreens growing? If you can, notice their needles, to see if they are all alike. What do children like at Christmas time? Try to have a tiny tree or a branch to decorate for the doll's house. Consult the Course of Study in Construction for suggestions for making decorations and gifts, and in Language for appropriate poems and stories.

JANUARY

OUTLINE FOR JANUARY.—*The weather, as last month. How our homes and schoolrooms are kept warm. Storm doors, etc. Trees as windbreaks. Kinds of fuel. Source and supply of wood and coal. Distinguish hard and soft wood. Hard and soft coal. Make bins, and put fuel supply in doll's house.*

Need and importance of fresh air. How to secure it indoors. Deep breathing, good positions, sitting and standing. Cleanliness—of clothing, of body, of surroundings. How to prevent and remove dust and dirt. Care of pencils, books, etc.

THE SEASON.—What do we call this season? What things make it pleasant? What things do we not like so well? Keep a record of stormy and pleasant days.

What must we do in winter to keep warm? How many ways do you know for heating houses? What do we burn in stoves and furnaces? Where do the wood and coal come from? Which kind of wood burns best? What kind of coal do we have? What is the difference? Can you build a fire? Tell how it should be done. Bring some samples of different kinds of wood and coal. Make some bins for the cellar of the doll's house and fill with various kinds of fuel.

What besides fires helps keep our houses warm? (Storm doors, windows, porches.) In what ways do trees protect us in winter?

PHYSIOLOGY.—What important thing besides food and water do we need to keep alive? Where is the air? How do we know? How does air enter the body? What makes the air in a room impure? Air that has been used by our lungs for breathing is not clean, just as water which has been used for washing is not clean. How can we tell if the air of a room is not pure and clean? (One

way is to notice the bad odor when one has just come in from the fresh air outside.) How can we keep fresh air in our homes and school? (In pleasant weather keep doors and windows open. In cold weather fill the rooms frequently with fresh air from outside, open windows slightly, to avoid cold drafts.) Teach pupils, by example, how to ventilate the school room.

How may we help the lungs to do their work well? (Plenty of exercise out of doors, erect sitting and standing positions, deep breathing of pure air.)

If our bodies and clothing are not clean, they do much to make the air of our rooms impure. How often should we bathe? How can we keep faces, hands, nails, hair, clean? How keep our school materials clean? (Keep pencils out of mouth, avoid wetting fingers to turn leaves of books. Keep desks dusted with damp cloth, etc.)

FEBRUARY

OUTLINE FOR FEBRUARY.—*The calendar. The birthdays of Washington, Lincoln.*

Sources of food in winter, how and where stored. Describe a visit to a grocery store in winter. Describe various ways in which foods are cooked—boiling, baking, etc.

The cow as the source of our milk supply. Its food, habits, care, especially in winter. Care of milk, importance of cleanliness? Its various uses? How butter is made. Milk supply of city.

PHYSIOLOGY.—*Good things for children to eat for breakfast, dinner, supper, for school lunch. Right habits of eating and drinking. Care of teeth, table manners, regularity and temperance in eating and drinking.*

THE CALENDAR.—How many days in this month? How many weeks? In what season is it? Keep record of clear and cloudy days. Record birthdays of Washington, Lincoln, Longfellow.

WINTER FOOD SUPPLY.—Make lists of the foods we eat in winter. Which have been stored since summer? How? Where? What foods come to us from far away? Who sells them to us? Describe a visit to the grocery store in winter.

In how many ways are foods cooked? Which are baked? Boiled? Fried? Toasted? Which are best for us?

Name foods that are best for children to eat for breakfast. For dinner. For supper. What things make good school lunches? (Teacher should give simple facts regarding foods.)

If our food is to make our bodies grow and be strong, there is something for us to do after it is prepared for us. (See Health Lessons for November and December.)

THE COW.—Think of all the useful things we get from the cow. Make a list of them. Where do cows live in winter? How are they sheltered? What do they eat? How provided with water? Describe the barn in which cows are kept. When is the milking done? What is first done with the milk? Where is it kept? How must it be cared for? Why should milk be kept very clean? Why kept cool?

How do people in cities get milk? How is it prepared and carried to them? Why should they wish to have it kept clean? How can it be done?

What foods are made from milk? Tell how butter is made. Have you seen cottage cheese made at home?

MARCH

OUTLINE FOR MARCH.—*The weather.—Note changes in length of days, in temperature, in amount of clothing. Is there as much snow as there has been? What things show the coming of spring?*

Animal Pets.—Kinds. Their names, habits, shelter, care; how secured.

The Cat; its food, care, habits. Its means of protection, usefulness, care of young. Wild relatives.

The Wind.—What the wind is; what it does, harmful and helpful?

THE SEASON.—At what time does the sun rise? Where? Notice when and where it sets. How have these facts changed since Christmas? Is there as much

snow as there has been? Are we having more cold, or warm days? What changes are we making in our clothing? Keep on the blackboard a list of the things that tell that Spring is coming. Watch for new signs each day.

ANIMAL PETS.—What pet animal have you at home? What is its name? How do you feed it? Where does it stay at night? In the daytime? Can it do any tricks? How does it learn? Why do you keep it?

THE CAT.—Why do we have cats about the home? What different things do they eat? How do they drink? How keep clean? How keep warm?

Why can a cat move so quietly? Watch a cat's eyes in bright and in dim light. What are a cat's whiskers for? Watch its ears and nose, when it is waiting for a mouse.

What different noises can a cat make? What do they mean? How does a cat play? Where sleep?

What enemies has a cat? How can she protect herself? What harm may cats do? Who are the wild relatives of the cat?

THE WIND.—What is the wind? What do we mean when we say it *blows?* How can we tell that it blows? Make a long list of ways.

What does a cold wind do? A warm wind? What does the wind do to wet clothes, muddy roads, etc. How does the wind work for us? How help us play? What harm may the wind do? Make kites, pin wheels, paper boats. Learn Stevenson's "The Wind."

APRIL

(Twenty lessons planned.)

APRIL.—*Springtime activities at home; house cleaning; putting up screens and awnings; cleaning yard. Repairs; identification and uses of a few carpenter's tools. Clean doll house and arrange for spring.*

Plant nasturtium in egg shells and in window boxes at school and home; later transplant to garden, border, or fence. Advantages of early planting indoors. Make yard and garden for doll house. Care of house plants; what plants need, —soil, light, moisture, favorable temperature, air (like animals). Identification of a few common house plants. (From Conference Course.)

A series of talks upon the general subject of the coming of spring may include the following topics:

THE SEASON.—What season have we now? What things tell us that spring has come? (Teacher write points on board, as given by class.) What games can we play now that we could not play in winter? Why? What different kinds of work can be done? Why? When does the sun rise these days? When does it set? How was it at Christmas time? Why is it warmer now? What difference is there in our clothing? What difference in keeping the house warm? (See Language Course for appropriate verses if desired.)

CHANGES IN WORK.—a. What kinds of work are fathers making ready to do, now that spring has come? Have the various kinds, especially those relating to planting, described briefly; aim to make the children interested and observant, and to organize a little more definitely their knowledge of man's relation to nature about him.

b. What do our mothers plan to have done as soon as doors and windows may be left open? Why do we wish to "clean house?" What do we do? (Clean carpets, windows, remove storm doors, paint, paper, scrub, wash, air bedding, etc.) What do we need to do at school? Children should perform some of the simpler tasks of "house-cleaning" at school. Desks may be washed, closets put in order, proper methods of dusting practiced, etc. Further work may be done with the doll's house. If none is at hand, make one by setting a small shoe box on end and putting a partition midway between top and bottom, cutting in some windows. Some of the pupils may add a roof. It can be painted, papered, furnished with cardboard furniture, woven rugs, and curtains. Much of this work can be begun in class and continued as seat work.

c. Cleaning the yard. What can we do to make our schoolyard ready for the spring? Clear away dead weeds and grass, remove papers and ashes. Tell

what is done at home. Plan a yard for doll's house. Measure space, cover with oil cloth or heavy paper, furnish with sod and some twigs for trees. Lay out flower beds and vegetable garden to prepare for the real garden work later.

BIRDS.—The bird-arrivals should be noted, now, though no detailed study is begun. Talks should center about such points as are suggested here. What birds have been with us during the winter? (Sparrow and bluejay, at least, are familiar.) How do they live? Why do we like them? What have you seen them do? What other birds do you know about? Where have they been all winter? Why? Why do they return? Which ones shall we look for first? How can we help them? Let us keep a list of them as we see them. How can we tell a robin from any other bird? A meadow lark? A blackbird? Draw and color them. Learn poem. Imitate songs of birds.

TREES.—Another source of joy in the springtime is a closer acquaintance with the trees. Choose a tree of familiar species, near school, for frequent observation. Visit it. Note its size; its location, if in any way significant. Tell how it differs in appearance from what it was last summer. Draw its outline, then cut out from paper. Watch for changes. Carefully gather some twigs and keep in water to let the children see at close range what is occurring in every twig of the tree. No detailed study should be undertaken.

OTHER LIFE.—Watch for all signs of reappearing life. Keep a list, (grass, dandelions, frogs, toads, pussy willows, etc.), to which pupils can bring additions each day.

EGGSHELL GARDENS.—For the eggshell gardens suggested for this month's work, materials are easily secured. A shallow box, partly filled with sand, is an excellent container for the eggshells which each pupil brings for himself. A profitable outdoor period may be spent getting the right kind of soil. Each shell should have a hole pricked in the bottom, and should be filled with soil. Two or three nasturtium seeds should be planted in each. The shells should then be labeled by writing name of child and the date upon each, and all arranged neatly in the tray of sand which is to be placed in the window. The needs of the "garden" are then discussed, and the owners charged with all necessary care.

RADISHES.—A larger box filled with earth may be planted with radish seeds. If an early variety is selected the vegetables may reach maturity before school closes, a particularly desirable point in work with small children.

WEATHER.—One of the children's pleasures during this month is the daily weather observation which is recorded upon the blackboard calendar. The state of the sky, direction of wind, and rainfall, if any, should be noted each day. Counting the number of clear, cloudy, and rainy days at the close of the month is a profitable exercise in comparison and in numbers.

THOUGHT AND EXPRESSION.—In all this work good thinking and clear, correct expression should be closely linked together. Good nature study work will demand good expression in language and vice versa.

TWENTY-LESSON PLAN.—The following outline presents twenty lessons for this month. The order must be decided by each teacher, to suit her own conditions. A ten-minute period will secure many good results, both in nature-study and in language. Some of the exercises may be given during seatwork periods, if the program is very much crowded, thus making opportunity for other work by means of "alteration."

1. Talk. Change of season.
2. Make pinwheel.
3. Change of farm-work because of seasons.
4. Change of home-work because of seasons.
5. Change of school-work because of seasons.
6, 7, 8. Make doll's house—Begin to furnish it.
9, 10, 11. Plan and make yard for doll's house.
12. Bird-talk; begin calendar.
13. Poem.
14. Visit tree; note signs of spring.
15. Talk on tree. Draw. Cut out drawing.

16, 17. Plan and make eggshell gardens.
18. Plant radishes in window box.
19. Clean yard and desks.

MAY

(Twenty lessons planned.)

May, 1915.—Garden studies at home, and, if possible, at school. Encourage flower planting,—nasturtium, four-o'clock, balsam ("lady slipper"); gourds, popcorn.

The robin, as a bird about the home. Its food habits, nesting, song, destruction of injurious insects. Other birds which are abundant and easily identified, such as flicker and meadow-lark.

GARDEN WORK.—The lessons this month follow closely the form of those preceding. Most children are interested in the garden making at home, and many participate in the work. These follow the school work with greatest intelligence and zest. Reports from all who do garden work at home, or who know of it there, should be given freely in class, with such reasons for the processes as children can understand. Next, the desirability of a school garden may be discussed. Usually the activity is sufficient motive, and "taking things home" a sufficiently desirable outcome, to enlist hearty co-operation. Pupils and teachers together should plan the place and size of the garden, the needful work in preparation, what, how, and when to plant, care, etc. Some of the work, like first preparation of soil can best be done by older pupils. Two or three outdoor lessons may suffice if the teacher's time is limited, and for part of the work an older pupil may serve as guide with profit to all. It is a saving of time, and will encourage a spirit of co-operation if all the pupils of the school work in the garden at the same time. To do this it is necessary that the work of each group should be so carefully planned beforehand that no confusion results. If the school is large it may be separated into two groups for outdoor work, the older pupils studying while the younger ones work, and the younger ones having an extra playtime while the older group is at work.

As the weather grows warmer during May the younger pupils may frequently be sent out upon independent excursions for brief periods. If careful limits are set for them, and definite problems given, it is rare that such privileges are abused, and usually much good results.

Preparatory to outdoor work, the children may tell of the home garden, where it is, how the soil is prepared, what is planted, which seeds first whether in rows or beds, and with reasons for so doing, simply given. They may bring seed catalogs for descriptions of products, and perhaps the seeds for the tiny school garden can be spared from the home supply. The course this month suggests four-o'clocks, balsams, gourds, and popcorn for planting. The uses and beauty of these plants should be talked about and the best places for planting decided upon. (Gourds and nasturtiums along walls or fences, corn where it will not hide smaller plants.) Pictures are of value in the work at this time. Transplanting the nasturtiums will recall the work of last month, and the advantages of indoor planting can be readily appreciated.

WILD FLOWERS.—The first spring flowers are always a source of interest and joy to the children. The longer school sessions may be broken midway for the little people by sending them out to see what wild flowers have appeared. Bouquets of dandelions or violets may be brought in, pupils encouraged to note where and how they grow, and taught to avoid the wanton and purposeless destruction of blossoms.

RAIN.—One or more lessons upon rain may be given, when an appropriate time comes. Why do we need rain? (Soft water for washing, cleans and cools air, makes gardens grow, fills creeks and ponds, gives water to drink.) How does the rain give us fun? ("Rivers" to sail boats, mud pies.) Why do we sometimes not like rain? (Bad roads, muddy shoes, spoils gardens, clouds hide sun.) Where does the rain go? (Soaks into ground, runs to creek, "dries up.") Learn poem, fold umbrella.

BIRDS.—Several lessons need to be given to continue the interest in bird life. The robin is perhaps most familiar, but the meadow lark and the flicker are very common, easy to approach, and are so definitely marked as to be easily recognized both by color and song. The children may go out and observe these for themselves, if carefully directed by the teacher, and give their reports in class-time. Colored pictures are useful in helping to remember. One child may hold a picture of a bird and describe it, while others guess what it is. For description of common birds see "Bird Descriptions" at the end of the seventh and eighth year lessons in this number. For the flicker and other woodpeckers see also pages 7 and 8 of leaflet Number Two.

ROBIN.—In studying the robin only such facts need be talked about as can be observed, but these are many. How can we tell if a bird we see is a robin? What have you seen a robin do? How long have they been here? Why did they come back to us? What do they eat? How many songs, or calls, has the robin? Facts regarding food, songs, nests, bathing, etc., can easily be learned by direct observation, and should not be told by the teacher. Pictures of the robin may be drawn and colored. Poems and songs may be learned.

TWENTY-LESSON PLAN.—The following outline gives twenty lessons for this month. The order must be decided by each teacher to suit her own conditions. A ten-minute period will secure many good results. Some of these lessons may be given during seatwork periods, if the program is much crowded.

1. Reports of home gardens.
2, 3, 4, 5. Plan and make school garden.
6, 7. Early wild flowers. Discussions. Gather. Draw and color.
8. Transplanting nasturtiums.
9. Rain.
10. Fold umbrella.
11. Birds. General talk.
12. Meadow lark.
13. Flicker.
14, 15, 16. Robin. Introductory talk. Visit. Report.
17. Picture lesson. Cut and color.
18. Poem.
19. Tree. Visit.
20. Story.

LESSON PLANS FOR SECOND YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER.—*Discussion of summer experiences and activities. Conditions of gardens started in the spring. Special study of radish-root, stems, flowers, seed-pods, seeds. Compare with radish used for food in the spring. Save seeds. Study of pumpkin or squash plant—habit of growth, leaves, flower, fruit. Gather seeds of other garden plants and preserve for spring planting. Gather popcorn and store.*

Notice any insects that are seen in connection with garden or wild flower study. What are they doing?

Devote the month chiefly to informal studies based on out-door observation. Common autumn wild flowers; gather and arrange in bouquets; note windblown seeds of goldenrod, aster, thistle, dandelion, etc.; make collection and chart of these "flyers;" note how far the seeds travel in the wind; where they alight.

A few most common birds; what they are doing; the places they prefer; their habits; where they spend the night.

VACATION.—Discuss informally the experiences of the summer. Where was the vacation spent? Who went to picnics, who did some work about the home? Who had a garden? Etc.

AUTUMN FLOWERS.—Find the various wild flowers growing along road sides and in the fields. Gather a few for bouquets. Study in a simple way something of the habits. Where these plants grow? How tall they are? Make a collection of the wind-blown seeds as suggested in the outline.

GARDEN.—Discuss the garden as suggested under lesson plans in September of first year. Make a detailed study of a radish plant that has gone to seed. Compare the root with the radish root that we eat in the spring. What do you think has become of the soft, tender portion? Notice the color and beauty of the flowers. Where are the pods? Open the pods to find the seeds. Put some of the seeds in envelopes to save for spring planting. Make a special study of a popcorn plant. Where the ears are borne. Gather and store some of the ears.

BIRDS.—Study birds as suggested in first year's work.

OCTOBER

OUTLINE FOR OCTOBER.—TREES.—*Review trees studied in first year. Add two or three others. Which makes the best shade? Why? Collect autumn leaves, press and make chart or border for room.*

FRUIT TREES.—Name those found in the neighborhood. Study, peach, pear, cherry, and apple tree. How can you tell the trees apart when there is no fruit on them? Bring in twigs and leaves of different kinds. What shrubs bear fruit for us? Gooseberry, raspberry, blackberry, currant. Identify these.

ANIMALS THAT WORK FOR US.—What each one does. Food of animals. Find different kinds of grasses, clovers, grains. Make collection of these and preserve to put in barn later in the year. Where are the different kinds of food stored? Who feeds the animals? Birds as suggested for first year.

TREES.—Follow the outline suggested in the first year for the study of trees. Note the different colors of the autumn leaves. Does each kind of tree have a special color? Which ones are the brightest? Have the children collect some of the prettiest leaves, press them and make a chart by pasting them upon cardboard. A very pretty border for the room may be made from these leaves.

Fruit Trees.—Discuss informally what trees bear fruit that we use for food. Let each child tell what trees are found at his home. Which trees have fruit on them now? Which ones ripen their fruit in the summer? Make a detailed study of a peach similar to the apple study suggested in November of the second year.

Bring twigs of various kinds of fruit trees into the school room. Note the

differences in the shape and color of leaves, and the color of the bark. Make a similar study of the shrubs that bear fruit for us.

ANIMALS.—Ask the children to name all the animals that work for us or help us in any way. How does each help us? What do these animals eat? Who has ever helped to feed the horses, or pigs or cows? Make a brief study of the different kinds of food eaten by these animals. Make several collections of different kinds of grasses from the pastures and meadows. Tie these up into very small bundles and lay aside to use in the barn which is to be constructed in the winter months.

In a similar manner study and collect the grains eaten by animals. Make small boxes out of paper and store small samples of each kind.

NOVEMBER

OUTLINE FOR NOVEMBER.—*The apple, in connection with Thanksgiving. Identify a few striking varieties, as russet, snow, greening, jonathan; qualities of each. Which keep best over winter? Significance of skin, core, pulp, seed. How did the apple "start" on the tree? Problem to be solved next spring. Save seeds; label kinds. How do "worms" get into apples? Decay; infection by contact. Storage. Methods of preparing for eating. Make Thanksgiving pie. Dried apples.*

Special study of the horse; uses, disposition, habits, fitness for service to man, care. Kinds of horses (including ponies) on basis of use, as carriage horses, riding, draft, racing horses.

(Eighteen lessons planned. Some possible combinations with language and physiology are suggested.)

SUGGESTED SCHEDULE.—The weather, and out-of-door conditions, three lessons. The apple, five lessons. The horse, four lessons. Poems and stories, three lessons. Health talks, three lessons. This schedule should be varied to suit the needs and conditions of each particular school.

THE APPLE.—Give a list of fruits which are gathered in the fall. Which of these can be kept fresh for the longest time? How many kinds of apples do you know? Bring as many kinds to school as you can. (Several kinds may easily be identified.) We can tell the russet by its tough, brownish green skin; the snow apple by its pinkish-red color, with a light green spot, and by its juicy, white pulp. The greening has a green skin; it is used often for cooking. The jonathan has a deep, rich red color. Ask at home which kinds are being saved for winter use. Why? Which kinds taste best now?

Which part of the apple do we like best? What other parts are important? Why? Cut an apple across, to see seed arrangement. How are the seeds protected? Why? Save some seeds. Make an envelope in which to keep them.

What made the trees look pretty last spring? What becomes of the blossoms? When can we watch to find out? Why do we not eat the apples when they are small? What ripens the apples?

How can you distinguish an apple tree at this time of the year? Examine one at home, carefully; tell us how it looks, and draw its picture.

What unpleasant things may happen to apples, while they are growing? How do worms get into apples? (The moth lays the eggs on the outside. A worm hatches, and eats his way into the apple.) What harm does he do?

How are apples kept for winter use? (Cool, dry place, no freezing. Experiment, to learn effects of freezing, bruising, of keeping in the warm schoolroom.)

In what different forms do we eat apples? Raw, baked, sauce, jelly, apple butter, dried. Let pupils string and dry some.

The juice of apples is useful, when pressed out. When fresh, it is often used to drink. When not fresh it is harmful. It is used in making vinegar.

THE WEATHER.—This topic should be a part of each month's work. So, also, should be the common out-of-door changes in nature, which are within the children's comprehension; *e. g.*, birds, trees, etc.

What month is this? What holiday occurs? How many days in November? Let us count the sunny days. How are November days different from those of last summer? What things out-of-doors are different? Tell how. What birds do we see now? How do they take care of themselves? How may we help? (Scatter

crumbs, or seeds, place food in trees, etc.) What changes have come to the trees? Draw pictures of trees in summer, and in winter. What is beautiful about them, at each season?

THE HORSE.—Name the barnyard animals. In how many ways is the horse useful to us? Why can they do the work we give them to do better than other animals could? They are strong, gentle, agile, swift, willing. How are they taught to work for us? Discuss harnessing and breaking, the intelligence, docility, friendliness of the horse.

What daily care do horses need? (Water and food, regularly, bedding, brushing.) What special care is needed at times? (Blanketing in cold weather, "rubbing down," shoeing, etc.) Try to watch a horse asleep. How does a horse get up? Find out how much grain and hay different horses eat in a day. Does a horse earn his food, and good care?

Watch horses that pass by, and those at home. What kinds of horses can best haul heavy loads? What kind are best for running? For our carriages? Tell the children, or let them tell, if they can, of the sturdy little Shetland ponies, the tough pony of the Indians, the beautiful horses of the Arabs. Show pictures. Notice how horses carry their heads.

HEALTH LESSONS.—Questions and suggestions as to good things for children's breakfast in winter. Eggs, milk, fruit, cooked breakfast foods with cream and sugar.

Eating often between meals is harmful because it does not allow the stomach to rest. If one's breakfast is very early, he may have a lunch before the noon meal. Eating slowly is more healthful and better manners.

Using a toothbrush keeps the teeth clean, helps prevent decay, makes a child look much more attractive. How can a small child earn money for a toothbrush?

POEMS AND STORIES.—Talking in Their Sleep, Over the River and Through the Wood, The Pumpkin, The Lark and Her Young are suggested as fitting in well with this work. A Thanksgiving story should not be omitted.

DECEMBER

OUTLINE FOR DECEMBER.—*Weather chart for December (see directions for October, first year). The snowfall; forms of flakes; the story of the raindrop; observation of clouds; snow as a covering for plants in winter and source of moisture in spring.*

Sky studies.—Apparent path of sun and moon; changing length of day; moon's changes; milky way; dipper; north star; Orion. Children report observations made at home under guidance of parents.

Popping corn; why it pops.

(Eighteen lessons planned. The number of lessons to be devoted to each topic is difficult to determine in advance. The teacher must make individual plans according to particular conditions. The month's work is rich in material, and opportunities for combinations with language and handwork are many. Time may thus be planned to better advantage in all subjects.)

SUGGESTED SCHEDULE.—Sky studies, seven lessons. Weather, calendar, and snow, four or five lessons. Health lessons, two. Christmas stories, poems, handwork, and decorations, five or six lessons.

SKY STUDIES.—From observation. Describe the direction from us of the sun, at its rising, at noon, at sunset. Go out of doors and trace its path by pointing, and by accurate statements. What kind of days, as to length, have we now? That is because the sun is with us so short a time and because it seems to travel in such a low path through the sky. We must watch to see how long this will be true.

Beginning when the moon is new, give directions for watching it, then have reports. Where, in the sky, did you see it? At what time? What was its shape? Which way did the "horns" point? Where was the sun—on which side of the moon? Why do you think it is called a "new" moon? Watch each evening, at about the same time. Make a picture of the moon each time. See if it is in the same place each evening. The moon shines because the sun throws light upon it.

Does that seem strange? Try to think, or ask some one where the sun is when you are looking at the moon.

When you are watching the moon look for a path of light across the sky. Ask some one its name, when you have found it. Try to remember its direction, and tell us next day. Notice if all the stars in this "Milky Way" are alike.

Look tonight for bright stars. People long ago gave names to certain groups of stars. Try to find the Dipper without any help. Be ready to make a drawing of it tomorrow, using the right number of stars. See if you can tell why it is also called Great Bear. (The handle of the Dipper is the tail of the Bear.) Ask someone to help you find the North Star, after you have learned the Dipper. This star is an important one to remember.

One of the brightest groups of stars in our sky is toward the south, in winter, and is called Orion. There is a bright star above, another below, and three across, midway between. Orion was a great hunter, and the middle stars are his belt. Get some older person to help find him.

Interest will be added to this work, and more definite results secured, if some written reports can be made. After the oral lesson, pupils may copy sentences like the following, leaving blanks to be filled at home.

1. The sun set last night at.....o'clock.
2. The moon was.....of me at.....o'clock.
3. The moon looked like this.....
4. I counted.....stars in the Dipper.
5. The North star was.....of me.
6. The direction of the Milky Way is from.....to.....
7. I saw.....stars in Orion's belt.

These papers may be used some day for a reading lesson.

THE WEATHER, SNOW.—Note out-of-door conditions as usual. When the first snow falls, take a little time to watch it coming down. How does the sky look? Where does snow come from? Tell class the story of a raindrop—drawing upon their knowledge and experience whenever possible. Catch some flakes upon a dark cloth. Notice their shapes. How many points has each "star?" Count many, to see if any differ in number. See if all are the same shape.

To cut a six-pointed star: Take a six-inch square of paper. Fold the back edge to the front edge. Mark the center of the folded edge. Fold the back right corner of the paper toward the left and downward past the middle; fold the back left corner to the right and downward, covering the preceding fold exactly, thus making three equal angles at the center point in the first folded edge. Crease. Fold the resulting figure double by bringing the slanting edges together. Crease.

Next, hold the figure with the point toward you, the open edge at the right. Place scissors on this open edge, one inch (or less) from the point, and make a very slanting cut back to the straight edge at the left. Cut this resulting slant edge into any fancy pattern. Unfold.

The teacher must work with class in making this.

What fun can we have with snow? Make cardboard sled. Can you make a real one, at home? Of what other use is snow? (Makes roads smooth for sleighing, covers plants, furnishes moisture for soil.)

See if you find any tracks in the snow. Can you tell what animals made them?

What makes snowdrifts? Where do we find them? Watch snow on the trees. Which hold most snow? Which are sometimes harmed by it?

HEALTH TALKS.—Most children need frequent suggestions and help in correct behavior while eating. The teacher can add materially to the comfort and happiness of the luncheon hour, by tactfully and sympathetically gaining the cooperation of the pupils in making of it a pleasant social time, in which self-control and courteous consideration go hand in hand with hygienic practice. This is also a good season in which to learn that excessive use of candy is unhealthful, and that the best time to eat candy is after one's meal. Much of this work can best be accomplished during the noon-time, when luncheons are eaten. Some may be done in more formal lessons.

THE CHRISTMAS SEASON.—Poems and stories which may have a particular appropriateness this month are:

While Shepherds Watched Their Flocks by Night.

The Sun's Travels, or Winter Time.—Stevenson.
Christmas Story of the Wise Men.
Some popcorn brought to school for study makes a good lesson. It may be popped and strung and used as Christmas decoration. Snowflake stars, cut and colored, may be used likewise.

JANUARY

OUTLINE FOR JANUARY.—*Shelter for farm animals; barns, sheds, poultry house, etc. Natural covering of the different animals. How wild animals spend the winter; hibernation. Construct barn, poultry house, etc., and barnyard, as in case of doll house in first year, and stock with foods collected in October. Make toy animals of clay, or paper.*

Our hands and arms. What they help us to do. Main parts of these members. Care of hands, nails, skin. The feet and legs. How they are useful. Main parts. Care. How to be strong.

SUGGESTED SCHEDULE.—Shelter and construction, six or seven lessons. The weather and out-door life, five lessons. Health talks, five lessons.

SHELTER.—What are the ways in which we protect ourselves from cold? What other beings about us need shelter? Which of these animals do we provide for. How are horses and cattle sheltered from cold and storm? Tell how barns are built, and arranged for horses and cattle. Tell about the mangers, floors, stalls, etc. Why is a barn warm? How does fresh air enter? How may bad air escape?

What part of the time do horses and cattle spend indoors? How are they protected when out-of-doors on bad days? On which side of a straw stack do they like to stand? Why do they need protection more than bears do?

Tell how a hen-house differs from a barn. Why? Describe the perches, nests, feeding-places. Discuss similarly the care of sheep and hogs, if time permits.

For what are the farm buildings used besides sheltering the animals? (The animals are fed there. Food is stored in them.) Why? (Comfort and safety. Prevents waste.) Name the kinds of food, manner of storing and of feeding to the various animals.

CONSTRUCTION.—Any number of farm yard buildings may be made out of small wooden or paste-board boxes, used as described in September, First year, for the doll house. Pasteboard boxes of various shapes and sizes, are perhaps better for a first attempt, as they are more easily handled. Partitions may be fastened in with glue or with paper-fasteners, as the class arrange and plan for them. Provision should be made for storing hay, fodder and grain, and bits of each kind of food should be put in proper places. The various animals may be cut from heavy paper, or better made from clay. Toy animals brought from home add even more interest. The tools and implements needed about a barn may be similarly provided. A yard may be added, as to the doll's house, if desired.

How are the barnyard animals given water in winter? Let different pupils describe in detail. Add a toy windmill to the farm yard equipment.

Still further care is necessary—the animals' shelter must be kept clean. How is this done? How does it benefit them. How does it benefit us?

OUTDOOR LIFE.—How do the wild animals that you know about spend the winter? Make a list of birds and other animals that you see. What is their food? How do the rabbits, squirrels, mice, etc., live and keep warm?

What has become of the frogs, toads and snakes? They are down in moist earth away from frost, taking a long sleep, until spring comes. We call this *hibernating*. Watch for the time when they come out. Why should they hibernate, when rabbits and squirrels do not? (Think what their food is.)

THE WEATHER.—Keep daily calendar on blackboard. How many sunny days? How many days can you skate? Go sleighing? Play snowball? What sports are best for this month? Make pictures to show.

Watch the time of sunrise and sunset each day for a week. Keep the record until next month, or longer.

HEALTH LESSONS.—Make a list of the kinds of work you can do. How do your hands help? How do you use them at play? What can we do, because

we have hands, that the animals cannot do? Try to feel how many bones in the arm. How do they make it useful? Find the joints. Tell their use. Find the joints in your hands. What if there were none? Try some day to see if you can count them.

Feel the muscles of your arms. Why do you wish them to be strong? Good food, fresh air, plenty of exercise at play, and helping at home make them strong.

Why do our hands need special care? Washing them clean, and drying them thoroughly prevents them from becoming chapped and sore.

Think how useful one's finger nails are. They should be trimmed with scissors or file, never torn or bitten. Biting them makes them very ugly, and one's fingers are not so skillful. Diseases may be easily spread by the dust that crowds under the finger nails. They should be cleaned carefully and often.

Think of the many ways in which the muscles and bones of the legs and feet serve us. If we wish the feet to do their work well, and without pain, we must wear comfortable shoes that have the shape of the foot. The feet need to be bathed very often, because we walk in dusty or wet places, and because our thick shoes do not allow the perspiration to escape.

FEBRUARY

OUTLINE FOR FEBRUARY.—*Weather chart for the month. Learn cardinal points. Special attention to direction of wind.*

The dog; habits, care, uses, kinds, wild relatives.

Use and care of eyes and ears. The voice. The sense of touch.

SUGGESTED SCHEDULE.—The wind and the weather, five or six lessons. Health lessons, five or six. The dog, five or six lessons.

THE WIND AND THE WEATHER.—Go out of doors on a bright day, at noon. Notice your shadow. It falls to the north. What direction is back of you? At your right? At your left? The sun helps us to remember two of these directions; what are they? Name familiar places north, south, east, and west of your home; of school. Pupils should give these in full statements, and point as they tell. They may also supply omissions in sentences like the following, then read them to the class.

My home is.....of our school.

.....is east of my home.

If these four directions are very familiar, teach the semi-cardinal points.

Apply this knowledge to observation of the wind. Let each pupil keep a calendar of his own this month, and record the direction of the wind each day by using the appropriate word or abbreviations. Note also if the day is cold, cool, or warm. At the close of the month, note carefully the wind-direction on cold days, warm days, etc.

Keep also a record of the time of sunrise and sunset for a week. Compare with last month's record. Save both for use later. How can you tell by your work if the daylight time is longer ? (Supper before dark, more play-time before dark, etc.)

HEALTH TALKS.—*The Eye.* What are some things our eyes help us to do? Try to do some easy thing when they are closed? (Blindfold a child; others put objects in his hand for him to recognize.) What helps you when you do not see? Can ears and hands take the place of eyes? How, then, should we treat our eyes? (Keep them clean; read with light falling on book, and shaded from eyes, book at proper distance from the eye; do not read in fading light; do not gaze directly at the sun, even for fun; do not rub the eyes. If eyes are not strong, consult a physician.)

The Ear.—What parts of the ear can we see? The outer ear helps to catch sounds and send them into the opening in the side of the head. How should we care for this outer part? (Keep it clean; never put anything into it, for any reason; never strike a person upon the ear; do not make sudden loud noises close to the ear.)

Inside the ear are wonderful tiny bones and tubes which help carry the sound to the brain. Striking the ear may harm these, so that a person cannot hear well.

See how far you can hear a watch tick, or a pin drop. If one cannot hear well, it is much harder to learn.

The Voice.—Think how useful it is every day. In what ways do we use it? Which of these are pleasant to hear? What kind of tones do we use on the playground? What kind give most pleasure at home or at school?

THE DOG.—Who has a dog at home? Why do you keep him? Tell all the different things your dogs do that are useful, or that give pleasure. How can one teach a dog to go after the cattle, or to carry a package, or to perform a trick?

How do dogs show that they are our friends? How do dogs defend themselves? What should we do if a dog seems cross? How can a dog show how he feels? (Bark, growl, whine, leap up, wag his tail, etc.) Each tell a story to show a dog's faithfulness, friendliness, or intelligence.

What care should we give to a dog? Clean place to sleep, coarse food, bones to gnaw, water. When do dogs sleep? Why do they like to go into water?

Watch your dog when he eats. What can you learn about his teeth? How does he drink? Can you tell a dog's track? How?

What kinds of dogs do you know about? Which are big and strong? Small, playful? Friendly? Cross? Which can run swiftly?

Teacher may tell stories of the Eskimo dogs, the St. Bernards, or others. It will be of interest to make a collection of pictures of dogs.

Story of The Dog and His Shadow, of Old Dog Tray, or of the Dog of Flanders, will be appreciated by the class in this connection.

What wild animal is like the dog? How are wolves like dogs? How different?

MARCH

OUTLINE FOR MARCH.—*Discuss various changes in weather, in plants, and in animals that indicate the approach of spring. Follow spring changes in soft maple, willow, or other trees. Place twigs in water, and watch development of flower and leaf buds.*

Special study of a rainstorm. How rain comes down, what it does when it falls, uses of rainwater. Simple story of a raindrop.

Continue observations of birds. Watch for the first robin, bluebird, blackbird, and others.

Plant seeds of nasturtium, pansy, four-o'clock, radish, lettuce, and pumpkin in window boxes. Pupils watch their growth and learn to care for them.

SUGGESTED SCHEDULE.—The season, three lessons. Rainstorm, three lessons. Birds, three or four lessons. Trees, three or four lessons. Garden, five lessons. Each of these time-allotments may be extended by outdoor trips, written work, poems and stories.

THE SEASON.—What things that grow out of doors show that spring is coming? See how many signs of spring you can find. Do the barnyard animals act as if they know spring is near? How do they show it?

Name the months that we have called winter. What month is this? To what season does it belong? In what ways can we tell that spring is beginning? (Longer days, warmer weather, tiny bits of green in places, buds swelling, birds coming, many changes in outdoor work, muddy roads, frost leaving earth, etc.)

Note time of sunrise and sunset on various days in the month. Children may ask older members of the family to help. Compare each of these with the others and with the records of last month. Let pupils tell the results of the lengthening days which they see.

Tell in a story, all the things which March brings us.

The lessons on this topic will be of greater value if not given consecutively.

A RAINSTORM.—Watch how the rain comes down. Think of all the places where the rain falls,—the fields, the roads, the ponds, the roofs, the walks. What becomes of it? In what places does it soak in? What becomes of that which does not soak in? How have you seen it running off? What does a rainstorm do to the roads? What happens to creeks and ponds during a rainstorm? Why?

What becomes of the rain which falls on roofs? Why is some of it saved? Tell all the ways in which we use rainwater. Why do we prefer it to other water?

How does the water or rain reach the sky? There is always moisture in the air about us. Did you ever put snow, or ice, or very cold water in a glass in a warm room? What happened to the glass? Where did the drops of water come from? See if you can prove that this is true.

Have you watched the spout of the teakettle when the water is boiling? What comes out? Sometimes the teakettle "boils dry." What has become of the water? Try this at home. What becomes of the water when the clothes are hung out to dry? Water passes from ponds, creeks, and the ocean up into the air in the same way. The sun and the wind help to take it, or dry it up, as we say.

When much of this steam or vapor rises high in the air we see clouds. Then tiny particles of vapor may blow together, and grow cold, until they make drops of water which are heavy enough to fall. Then we have rain.

Watch for any little pools of water on the walks or other places from which you think the water dries up, or evaporates.

BIRDS.—What birds may we look for that have not been with us all winter? Which come first? (Bluebird, robin, songsparrow, meadow lark and blackbird will probably be noticed first by the children.)

Where have the birds been all winter? Why have they returned? Where were the birds when you saw them first? How did you know what they were?

Describe one of the birds that you saw, so that the class may guess what it is. Do not tell its name. Tell its song, if you can.

What can the birds find to eat when they first come back? (Early insects.) Where do they stay at night? (In sheltered nooks. They like evergreen trees. Why?)

What harm may come to them now? How can we show that we are glad to have them come?

Keep on the blackboard a list of birds, telling date on which they were seen, where seen, and by whom.

Good colored pictures of birds are helpful in this work. A pupil may take a picture, describe it accurately and carefully, and ask someone to guess the bird's name. This makes an interesting language lesson.

TREES.—Name and locate trees of as many kinds as the pupils know. Elm, maple, willow, cottonwood, oak and the fruit trees will probably be included in the list. It is important to locate definitely the particular trees mentioned that the teacher may be sure the pupils are talking intelligently about them.

Visit some of these trees. Choose one for special study. Note its height, the shape and size of the top, direction of branches, etc. Note the picture it makes against the sky. How does it differ in appearance from last summer?

Get a few twigs from the tree. Look carefully, then tell what you think may happen. Put them in water, and watch them every day.

What happens to the buds? Notice where the buds are placed, what their covering is, what grows from them. Are they all alike?

Keep them fresh by changing the water, and prevent their getting too warm.

What becomes of the bud scales? Watch the leaves unfold. What color are they? What besides leaves grow from the buds? Which come first, leaves or flowers? Watch carefully what becomes of the flowers.

Keep the twigs as long as possible. When the buds have developed get a few more from the tree, and compare.

Draw and cut pictures of trees showing the early Spring aspect.

GARDEN.—Before outdoor gardening is possible for the little ones their interest may be aroused and given intelligent direction by indoor work. There is perhaps no pleasanter way to begin than by making window gardens in the schoolroom. The "eggshell" garden will probably be most attractive to the children. It permits greater individuality in the work, and makes transplanting somewhat safer, especially if the plants are taken home for that purpose.

The eggshell should have a hole pricked in the bottom for drainage, and then be filled with soil. Two or three seeds should be planted in each shell, and carefully covered. The shells should be marked with the owner's name and the date, then placed in a shallow box of sand for safe keeping. The seeds mentioned in the outline are suitable for this work.

Where shall we keep the seeds now? What do they need? How can we take

care of them? These matters should be considered in class, and the responsibility for good care should be left to the owners.

Pupils enjoy keeping a written record of this garden work, and can thus practice several needed points in written forms. A record might read something like this:

March 4, Monday. I planted three cabbage seeds in an eggshell. I put the eggshell in a box of sand.
March 5, Tuesday. I watered my seeds.
March 6, Wednesday. I did not see anything.
March 7, Thursday. I did not see anything.
March 8, Friday. I gave the seeds more water.
March 9, Saturday.
March 10, Sunday.
March 11, Monday. I saw two sprouts. I gave them water. Etc.

In any of this work beginnings in written composition may be made by giving the pupils a series of written questions, the answers to which form a connected account of some subject of study. For example:

Where does the rain come from?
Why do we like rain?
What does rain do for plants?
What does rain do for animals?

The Language Course contains poems and stories which will add interest to the nature study of the month.

APRIL AND MAY

OUTLINE FOR APRIL AND MAY.—*Continue the study of weather, as before. Study hen and chickens. Where do hens make nests? Gathering eggs—their sizes and colors. Setting the hens. Caring for them. Chicks—their food, care, enemies. Make poultry house and yard. A comparative study of ducks, geese, and turkeys with chicks if time permits.*

Identify common wild flowers. Keep fresh bouquets at school. Plant wild flower gardens at home and at school.

Begin to make plans for next fall's exhibit of flowers and vegetables. Advise with pupils as to individual gardens at home. Seeds suggested for March planting are good. Plant various kinds of gourds as screens for outbuildings and fences.

Make a trip to a pond to observe life in the water. Special study of frog's or toad's eggs and tadpoles. Follow life history in aquarium in schoolroom.

Continue observations of birds and trees as in last month.

THE SEASON.—Problems similar to those given last month may be continued, and the varied out-door interests will suggest many more. A large number of topics is suggested this month for use in schools which are in session during May, and because we wish to put the children into active touch with the wealth of material which the springtime affords. Now the grass is growing, the leaves are out, the birds are building and singing, the field work has begun,—life is stirring, everywhere. Our calendar will scarcely afford room to record nor the day give us time to discuss the riches of the season as they crowd upon us. The topics here suggested are but a few of those which are easy of access and full of interest.

HEN AND CHICKENS.—A visit by the class to some poultry yard gives interest, reality, and unity to this work, and is most desirable when it can be done.

Who of you have chickens at home? What kind are they? Tell how they look. How do you care for them?

Where do the hens have their nests? Who gathers the eggs? Do you like to do it? Why? Notice if the eggs are all the same size, and color.

What are some of the hens doing in the spring time? Where do they sit? How many eggs are put in a nest? What must the hen do with them? What does she do for food and drink? How long is it until the eggs hatch?

Describe the little chickens when they are first hatched. What is their food? How do they drink? How does the mother hen care for them? How do people usually help the hens that have chicks to care for? (Provide food and water, coops for shelter.) What harm comes to chicks sometimes? (Storms, hawks, weasels, skunks.)

CONSTRUCTION.—If the barnyard construction suggested for January has been preserved, a poultry yard and house may now be added. If not, it may be made independently. A good-sized cardboard box of suitable shape may be used, and perches with tiny boxes for nests may be made and placed in it. Small feeding pens may be outlined, and floors covered with sand. Watering pans may be made of clay.

Coops may be added by making small rectangular boxes of cardboard, leaving one side open. Cut slits with a small sharp knife, opposite each other, along the vertical sides of the opening. For slats cut narrow strips of cardboard and stick through the slits across the opening. A triangular coop is even easier to make. Fold an oblong of cardboard so that it will stand thus A. Cut slits opposite each other, and stick narrow strips of cardboard through as before. The yard is now ready for its occupants, which may be made from clay, cut from paper, or toy chicks brought from home.

If time permits it will be very interesting at this point to study ducks, geese, or turkeys in comparison with chickens. Pupils should report upon likenesses and differences in habits, food, care, usefulness, etc.

WILD FLOWERS.—The common wild flowers of the vicinity should be noted in their natural surroundings. Violets, dandelions, etc., may be gathered for school and home decoration, each kind making a bouquet by itself until pupils learn how to make combinations that harmonize. Children should be taught to pick the flowers with long stems, and to gather only as many as will be cared for, thus influencing them against wanton destruction.

A source of great pleasure in many places where it has been tried is the making of a wild flower garden. A few violets, hepaticas, bloodroots, trilliums, and Dutchman's breeches brought from the woods and planted under a tree or in a shady corner will amply repay with early blossoms the slight care they need and will be a perennial joy to all.

GARDEN WORK.—The plants in the eggshell garden will now be ready for transplanting. Whether they are put into a school garden or taken home depends upon circumstances. The chief thing to secure is the children's intelligent interest in the nurture of the plants. This can usually be attained best through the individual garden at home, which is the result, in part at least, of interest and knowledge stimulated at school.

Discuss the reasons for transplanting. What do the plants need, now that they are growing so large? How can we provide more soil and room, and see that they have water and sunlight? How shall the soil be prepared for the little plants? What is the best time to move them? How shall they be put in their new places?

This month we should make plans for a garden exhibit in the fall. Pupils should be encouraged to plant only a few vegetables or flowers; perhaps only one kind, and make that as good as it can be. Tomatoes, cabbages, nasturtiums, four-o'clocks and asters are satisfactory plants for this purpose.

In class the teacher and pupils may examine pictures of these plants in catalogs, decide what each pupil will have, discuss how it is to be planted and cared for. A written lesson will help impress the facts upon the memory, and a record kept at school of the work each pupil does and of the progress of his plants will sustain his interest and effort when the novelty of the work begins to lose its force.

An interest in maintaining the good appearance of the school premises may be secured by planting gourds, wild cucumbers, or other similar vines along fences, or as screens for outbuildings. This is so easy to do that the small pupils can thus become helpers in the school family. They will enjoy the gourds in the fall.

POND LIFE.—Make a visit to a pond and see how many live things you can find. Watch for toads and frogs. Where have they been all winter? What are they doing now? How many different things can you see them doing?

Some of the toads and frogs have laid eggs in the water. The eggs of the toad look like long strings of black beads in a clear jelly-like substance; those of the frog are in a mass, not a string, so it is easy to get the kind one wishes.

Some eggs can be kept in a low, wide, glass bowl partly filled with pond water. They will hatch in a few days, and must be watched very closely or the changes will escape even the sharpest eyes. Only a few should be kept as the tadpoles are likely to starve if too many are in the bowl. Water plants and water from the

pond should be used to supply food for the growing tadpoles as they subsist upon the minute plant forms from the bottom of the pond.

Questions such as these should be answered as well as possible from observation:

How many days from the time the eggs were brought in until they hatched? What is the shape of the tiny tadpole? What does it do? How does it eat? How does it get the air? When do its legs appear? Which ones first? What happens to its head? What becomes of its tail? Here again a written record is of much value. It emphasizes the need to "be sure you are right, and then look again."

BIRDS AND TREES.—The nest-building activities of the birds will attract most attention from the children at this time. Quiet and patient watching of some neighborly robin or flicker will be repaid by many unusual opportunities for close acquaintance and friendship between the birds and the children. The building of the nest, the feeding the young, and the teaching to fly can all be seen by a little quiet effort.

Closer acquaintance with the trees comes with observance of leaf-forms. Leaves may be drawn and colored, gathered for bouquets, and in various ways be identified with the trees which were made familiar by earlier study.

LESSONS FOR THIRD YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER.—(*Ten minutes daily; or, preferably, three* 15 *or* 20 *minute periods each week. Alternating with fourth year work.*) *The garden; follow up spring work of school or home. Have each child make list of vegetables grown in home garden. Special study of tomato plant; different kinds of tomatoes brought from home; select the best and prepare seed for storage; note general habit of plant; height; methods of supporting plants from ground. Uses of tomatoes in the home; how cooked; how kept for winter.*

Climbing plants; morning glory, wild cucumber, sweet pea, gourds, woodbine, bittersweet, etc. Identify as many as possible; study manner of clinging to supports. Save seed for planting.

THE FALL ASPECT OF THE HOME AND THE SCHOOL GARDEN. LESSON 1.—This lesson should consist of an informal discussion of the garden. Have the children recall what seeds were planted in the spring. Who of the children have gardens of their own? Who have done any work in the home garden during the summer? How many have grown both vegetables and flowers? Are any of the flowers in bloom? Have any of them stopped blooming? If there are any flowers and vegetables in the school garden, use those for special study.

Ask the children to look in the garden and flower beds at home and come tomorrow ready to tell how many different kinds of vegetables and flowers they find there.

LESSON 2.—Ask the children to report on their observations made at home. Let one of the children pass to the board and write the names of the different kinds of vegetables and flowers reported. Then take up various ones for discussion. Which of these plants are still green and fresh, and which ones are dry and dead? Which may be stored for future use and which ones have been used earlier in the season?

LESSON 3.—(For this lesson the teacher should have in class several different kinds of garden and flower seeds, raised in the neighborhood.) Study different methods of seed forming among the garden vegetables. Notice the flat pods of the beans and peas. Open some of these to find the seeds and note how the seeds are fastened to the pods. Will these pods break open if left on the vines?

Study the round pods of the radish and open up to find the seeds inside. How do these differ from the pods of the beans and peas? Notice the flying seeds of the lettuce. A few minutes may be given to discussing how these seeds may be gathered and stored for use next spring. If there is a school garden gather and store some seeds.

LESSON 4.—Continue the discussion of the vegetables by having the children report on the part of each used for food. Have them notice the fruit of the squash, the pumpkin, and the tomato, the roots of parsnips, carrots, beets and sweet potato, the tuber of the potato, the seeds of corn, beans, peas, and the leaves of lettuce, cabbage and the stems of celery. A brief discussion of how some of these may be stored for future use may be worth while.

THE TOMATO. LESSON 5.—How many children have tomatoes in their home garden? Do the plants stand up tall and straight, or do they trail upon the ground? Has anyone fixed supports of some kind for the tomato plants? What is the advantage of these supports? (They keep the vines from trailing upon the ground so that the fruit may be held up in the sun and light.) Are there any flowers on the vines, any green tomatoes, any ripe ones? Ask each child to bring at least one tomato flower for study the next day.

LESSON 6.—(The teacher should have in class a portion of a tomato plant with some of the flowers and fruit in various stages of development.) Where are the flowers? Does anyone know how early the first flower appears? (Sometimes the plants begin to blossom the last of May or the first of June.) What is the color of the flower? What part of the flower stays on to make the fruit which we

eat? (This may easily be observed by looking at the tiny green tomatoes which are just beginning to form. The children will see that it is the little knob-like part in the center of the flower. If they wish to know the name, tell them it is the ovary, the lowest part of the pistil.) Ask each child to bring one ripe tomato for the next day's lesson. They may be told that the tomato is a good example of the kind of fruit that we call a berry.

LESSON 7.—(If the teacher can have in class two or three tomatoes of choice varieties they will add to the interest of the lesson.) Have the children examine the different tomatoes brought in and then decide whether or not all are the same kind. Which ones are the finest looking, the smoothest, the best shape? Can we tell just by looking at the outside of tomato whether or not it is the kind we want to save for seed? What are the things we like to have in a tomato? (The points may be brought out that we desire thick, juicy meat, of sweet flavor, and very few seeds.)

Cut the tomatoes crosswise through the middle and compare different ones as to the amount of meat and the number of seeds. Where are the seeds? Are they fastened to the pulp of the tomato? (If you are not sure of this, cut open a green tomato, which will show how they are attached much better than a ripe one. If the drawing is correlated with nature study, this cross section makes as excellent object to sketch or paint.)

LESSON 8.—Let the children decide which of the tomatoes studied in Lesson 7 they prefer to save for seed. How shall we save the seed? How is it done at home? Remove the seeds with as little of the pulp as possible. Wash the pulp out and spread the seeds on a piece of paper to dry. When dry place in an envelope, label neatly, and put away for the winter. (This work may be done by the pupils in a study period.)

LESSON 9.—Discuss the value and uses of tomatoes. Let one child write on the board while others name all the different ways that tomatoes are used for food. They will probably name most of the following: stewed, stuffed and baked, fried, cooked with corn, scalloped, sliced, and made into salads. How are they kept for future use? Canned, preserved, and pickled. It may be worth while spending a short time telling the children of the canning industry. This will help them to see how plants that are grown in their home garden mean the making of a living to people in other localities. Perhaps some of the children have visited canning factories. If so, they should be given the opportunity to tell what they have seen. At least the children should know that in the vicinity of towns where canning factories are located many people plant large tracts with tomatoes. These are gathered and taken to the factories, where other people peel and can them. The children will probably know that the cans used are made of tin. The cans are then shipped to all parts of the country, where grocers sell them for people to use in their homes.

CLIMBING PLANTS. THE MORNING GLORY. LESSON 10.—Ask the children how many of them have morning glory vines at home. Where are they growing? How high are they? How do they manage to grow so high? Look at the vines to determine how they climb. (This should be an observation lesson either at home or at school. The children will find that the morning glory vine climbs by twining its stem around some support.) Do all the stems twine in the same direction? What is the advantage to the plants of the climbing habit? Could the stems grow as tall as they are and stand erect without also growing much thicker?

THE LEAVES. LESSON 11.—Are there many leaves on one stem? Where are the leaves? Do you find as many on the side of the stem next to the window or the support as on the outside? Are they close enough together to make a good screen? Is this a good vine to use to cover ugly buildings or fences? Is it a good one to train over a window or a porch to keep the sunlight out? Ask the children to observe the vines at home to note the position of the flowers and to look at the flowers in the evening and again in the morning. Ask the children to bring to class a few flowers that have already opened and a few buds. What time of the year does the morning glory begin to bloom? Have the children try to recall the first time they saw the flowers this year. (Morning glories often begin to flower the latter part of July.) Do they continue to flower all the rest of the summer? Do

the flowers stay open all day? Did anyone ever arise early enough to see the flowers open up in the morning? Why are they called morning glories? Does a flower open more than once? (Leave this as a problem to be solved by observation. Mark the flower by tying a string around the stem or in some other way, and then watch to see if it opens more than once.) Examine one of the flower buds. Notice how it is twisted up at the end. Compare this with the closed up flower.

LESSON 12.—(Have in class some flowers that have just ceased blooming, some that are two or three days old, some green seed pods and some that are almost ripe. Have the children try to determine what part of the flower developed and made the fruit or seed pod. What is the shape of the pod? Open it up to find how many little apartments are in it. What is the color of the seed? Do the pods break open and scatter the seeds?

(Morning glories sow their own seed, by the pods bursting and throwing the seeds a short distance from the plant. The seeds lie in the ground all winter and start to grow early in the spring.) Who knows the wild morning glory? This is a very bad weed that is sometimes found in our cornfields, sometimes it almost covers the wire fences around the fields. It blossoms in the summer, having a large white flower similar in shape to that of the tame morning glory.

LESSON 13.—Tell the children to look for other climbing plants about the home and school. Which of these are planted each year, which ones live year after year? How do these vines climb? If possible, study the sweet pea or the wild cucumber to find the small tendrils which these vines use in climbing. Have the children examine grape vines to see how they climb. Then have them make a list of all vines they know that climb by twining and those that climb by tendrils. They may find some that use both methods. Do they know some vines that live from year to year? (Perhaps some may have the woodbine, wistaria, honeysuckle or some other perennial vine at home. If so, spend some time identifying and studying them.) Have the children decide which they like best of all the vines they know. Which are good ones to plant in the school yard next year?

LESSONS 14-15.—Make plans for the Harvest Home Festival.

OCTOBER

OUTLINE FOR OCTOBER.—*Note seeds scattered by wind, by floating on water (curly dock), clinging to coats of animals (burs), indigestible seeds of edible fruits scattered by birds and squirrels (berries, etc.). Make chart of various kinds of burs ("stickers"); make chairs, etc., from burdock burs. Identify and observe habits of social insects, bees, wasps, ants. Collect caterpillars and chrysalis or cocoon of various forms and keep in schoolroom; discover food plant of caterpillars and study feeding habits; note changes.*

(Seventeen lessons planned.)

THE DISSEMINATION OF SEEDS. LESSON 1.—Begin the lesson by calling attention to the fact that everywhere plants are beginning to wither and die. Are the garden plants as fresh as they were a month ago? Name some plants in the garden that are no longer green. What have these plants done to get ready to produce new plants next year? We gather the seeds from the garden plants and save them to plant next spring. Do wild flowers and weeds make any preparation for a new crop next year? What provisions have they made to scatter and plant their seeds? Ask the children to bring to class tomorrow some seeds of weeds and wild flowers. If possible, bring some milkweed pods. (The teacher should have a collection of milkweed pods, thistle heads, dandelions, wild asters.)

THE MILKWEED. LESSON 2.—(For this study the teacher should have an entire milkweed plant, with as much of the underground portion as possible.) Where do milkweeds grow? (Let the children name all the places in which they have seen these plants growing.) Why are they called milkweeds? (No doubt every child has seen the milky juice that has poured from the plant wherever it is broken.) Have the children ever seen animals eat the milkweed? (The milky juice is bitter and distasteful to most animals, hence they leave it alone.) Notice the leaves of the plant. Are there many or few? Are they still green or have they stopped

their work? Where are the pods? Are they arranged singly or in clusters? Who has ever seen a milkweed flower? (This plant has a dense cluster of greenish lavender flowers. It blossoms during July and August.)

LESSON 3.—Carefully open one of the closed pods. How are the seeds arranged? What is the color of the seeds? What is attached to one end? Take out a few of the seeds and notice how the soft, silky portion spreads out. What is the use of this feathery part? Throw a seed upward, and notice how the umbrella or parachute carries the seed along through the air. Watch the seed alight. Which comes down first, the seed or the parachute? Is the seed attached firmly to the parachute? Strike it gently to see if it will drop off. (Sometimes the seed as it floats along strikes some object and drops, leaving the parachute floating onward. Sometimes the seed flies far away and the parachute and the seed settle down together. It is in this way the milkweed seeds are planted. Sometimes the seed travels many miles from the parent plant before it settles down to produce a new plant next year.)

LESSON 4.—How many seeds in one pod? (The children may count the seeds in several pods to see if they vary. Look at the inside of the pod after all the seeds are out and note how velvety and smooth it is. Do the milkweed plants die in the fall, or do they live all winter? (To help solve this problem examine the portion of the plant that was in the ground and find the rather thick root and root stock. Milkweeds live on year after year. The stem and leaves die, but the part that is in the ground lives over winter. In the spring it sends up new stems, blossoms, and bears seeds another year. So you see the milkweed has two ways of starting new plants every year.)

LESSON 5.—Ask the children to bring in other specimens of fly-away seeds. (Among these they will find the dandelion head, the thistle, golden rod and wild asters.) Look at the fluffy dandelion ball. How are the seeds fastened to the rounded stem? Notice the long, thin stem of the parachute fastened to the small, hard seeds. Watch how the seeds sail away, high up in the air. Are there many dandelion seeds on one plant? Can you see why so many dandelions grow up in the yards and pastures each year?

Now look at the thistle head. How many of the children know the flower of the thistle? How many have ever seen bumble bees feeding on the purple flowers? Have any seen the wild canaries or goldfinches feeding upon the seeds of the thistle? (The goldfinch is very fond of thistle heads, and because of this it is sometimes called the thistle bird.) Have the children pull the head apart to find how the seeds are fastened to the parachutes. In the same way examine the other fly-away seeds.

LESSON 6.—Start a chart of seed fliers. Procure a sheet of stiff cardboard and arrange five or six seeds of each plant in a group. Stick these to the cardboard with common mucilage or library paste. This may be done either in class or at a study period.

LESSON 7.—Ask the children to think of some seeds that fly away by other means than by parachutes. Recall the maple seeds studied in the spring. These seeds fly with wings that carry them away from the parent plant. Make a collection of winged seeds for the chart and spend one day in studying them and finding out how they fly. Among these they will find the box elder, ash, catalpa and hard maple.

THE BURDOCK. LESSON 8.—Some plants have other ways of distributing their seeds. Can you think of some that take hold of your clothing or the fur of animals and are carried into new fields? How many know the burdock? Where does it like to grow? (It is found in vacant lots, by the roadside, among the shrubbery and sometimes in pastures.) Ask the children to bring some of the burs for the next day's lesson. Tell them to notice how tall and straight the plant grows, whether it has large or small leaves, and whether there are any flowers still left on the stems?

LESSON 9.—(The teacher should have in class some of the large burdock leaves and a stem, with small leaves and the burs.) Have the children report on the observation made outside of school. Did anyone find plants with large leaves growing close to the ground? Did these plants have stems with burs on? (These plants grew

from seeds last spring. They will send up tall stems and have flowers and burs next year. Burdocks live two years before they have seeds, hence they are called biennials.) Count the number of burs on one branch. Look at one of the burs and determine what enables it to hold fast to your clothing. Are these hooks on all sides?

LESSON 10.—Where are the seeds of the burdock? Look down into the center of the bur and find the seeds nestling down in the middle. Remove and count the seeds found in two or three burs. Do you think all of the seeds are likely to fall out of the bur at one time? (They do not. When you carry a bur on your clothing one seed after another falls out, so you are really sowing the seeds as you walk along.)

LESSON 11.—How can we get rid of burdocks? Will the plant die if you cut the root off below the surface of the ground? Here are some interesting experiments worth trying: Cut one plant off just below the surface of the ground. Cut another two inches below the surface. Cut the upper part from another and pour kerosene on the root. On another place a little muriatic acid, and on yet another place some salt. (If possible, let the children start these experiments at home, marking the various ones, so that they may be identified and later report on results. Let the children think of other ways to prevent new plants of burdock coming into their gardens. Among these should be mentioned the fact that the plants should never be allowed to go to seed. When they begin to flower, the stems should be cut down and burned.

LESSON 12.—Have the children bring in other seed stickers. (Among these they will find the cockle bur, Spanish needles, beggars' lice, and wild carrot.) Make a study of each of these, having the children determine how these seeds manage to catch a ride and travel far away from the parent plant.

LESSON 13.—Make a chart of seed stickers on cardboard similar to that of the fly-aways. These seeds may be arranged in very pretty designs on the cardboard. The children may also make out of both burdock and cockle burs very interesting baskets with handles, armchairs, and even tables, sticking the burs together with their hooks.

SEEDS THAT FLOAT. LESSON 14.—We have found that some seeds are carried out into the world by the wind and others carried by animals and people. Can you think of other ways in which the seeds may travel? A few seeds that you know float upon water. If the milkweed seed happens to alight in a stream of water it does not sink, but floats away on the top. Look at one of the brown seeds and find the thin part around the seed that enables it to float. Do you know the seeds of the curly dock? You will find them in great brown bunches at the top of the dock stem. Place some of these seeds in a pan of water and watch to see what they do. These are very good swimmers and may be carried long distances from the parent plant by little streams of water.

LESSON 15.—There is still another kind of seed traveler that you will be interested to know. How many of you know the pig-weed that grows so abundantly in the gardens? Bring in a few of these weeds and have the children find the tiny black seeds. Some of the pig weeds grow tall and straight, some creep along on the ground, while others spread out like a great round ball. The round ones break off close to the ground and the wind rolls them over and over, and they scatter the seeds as they roll along.

Ask the children to look for tickle or Old Witch grass, that tumbles along in the same fashion. Sometimes on a windy day the wind catches these up from the ground and they float long distances and collect in great brown piles in the corners of the hedges and fences. Have the children bring a few of these to the class and examine them to find the tiny seeds that are scattered as the plant tumbles over the field.

WOOLLY BEARS. LESSON 16.—This is a good month to find out how some of the insects get ready for winter. Ask the children to watch for caterpillars and bring them to school. How many know the woolly bears? (They are the common caterpillars with long, light tan or cinnamon brown hairs.) Place a few of these in a pasteboard box and feed them. They are fond of the leaves of sweet clover, smart weed

and beets. See if the children can find how many feet these caterpillars have. What is the color of the head? How does the caterpillar eat? (While the children may not be able to catch the insects in the act of eating, by looking at the leaves they will be able to determine that they have biting mouths.)

LESSON 17.—Some of the woolly bears will spin cocoons in the box. Perhaps the children may find out how the spinning is done. (The caterpillars spin a very loose covering of silk with their mouth, and then complete the cocoon by shedding the long hairs from their body. After the caterpillars have spun their cocoons, carefully cut open one of them to find what is on the inside. (Instead of the caterpillar you will find an object which we call the pupa.) What is the color of the pupa? Is it longer or shorter than the caterpillar? Can it move about or eat? How does it show that it is alive? (It will probably wriggle the back part of the body just a little when it is disturbed. The pupa will sleep all winter inside of the cocoon. In the spring it will change into a pretty white moth. Put the boxes away where they may be kept safely until spring, so that the children will have an opportunity to study the moths when they emerge.)

If the children become interested in caterpillars, they will bring in a number of different kinds. Among these will probably be found the Tiger Isabella. This is the common black and brown caterpillar. This one will not spin a cocoon and the children may be interested to know that it spends the winter in the caterpillar form. It creeps into some crack or crevice, under sticks or boards, or leaves, and sleeps during the winter months. Early in the spring it spins the cocoon and changes into a moth in a short time.

NOVEMBER

OUTLINE FOR NOVEMBER.—*Special study of nut trees, including oaks; if possible organize a nutting party; collection of nuts. Plant some in a box of sand out of doors. What animals eat nuts? Prices of different kinds at store. Different ways in which nuts are used as food. Crush a nut on a piece of paper and note oil spot, like butter spot. Make collection of nuts.*

Autumn activities of farm, orchard and garden, how products are exchanged. How taken to market.

Children construct out of paste board and sand tables, a farm house, all other farm buildings and surroundings. Some of the class may make the house, others the barn, still others the poultry house, etc.

LESSON PLANS—NUT TREES.—The purpose of the study of nut trees is to help the children appreciate more keenly the life and work of trees in general and the special value of nut trees both for ornamentation and for food. Begin the work by having the children name all the nut trees they know. Who has ever been nutting? What kind of nuts did you find? Let the children tell their experiences as an oral lesson in language.

Choose one or two nut trees in the district for special observation. In many districts the walnut is abundant and this is a good type for study. Ask the children to observe the tree and report. Is the trunk straight? Is the bark rough or smooth? Are the furrows deep or shallow? Are they far apart or close together? Follow one along some distance to see whether or not it meets another furrow. Do you think you could draw the bark pattern of this tree? How far are the first branches from the ground? Are the branches large? Are they the same color as the trunk? Are there many small branches? Where are they most numerous?

Bring in a few twigs for indoor observation. Have the children look for all the things that are to be found on a twig. (They will find tiny buds for next spring, leaf scars, and rings showing the year's growth.) Discuss the kind of leaves that the walnut tree has. If the children do not know, try to find some of the dry leaves under the trees and bring these for observation. Did you ever see any of the flowers of the walnut? We shall watch for these next spring.

What is the use of walnut trees? The children should know at least that the wood is hard and strong and a pretty dark brown in color. It takes a good polish easily, which means that it is a good kind of wood to use for furniture. Years ago it was used largely for furniture. Perhaps some of the children may be able to tell of some old walnut tables or dressers that their mothers have at home. Walnut trees

have become so scarce that the wood is now very expensive and so people care more about it in these days than they did years ago. Walnut is also good for fence posts. Some farmers have walnut groves upon their farms which they allow to grow for twelve or fifteen years and then use the trees for posts.

Where do you find nuts on the walnut tree? Do they remain hanging on the twigs late in the fall or do they drop to the ground? Describe a walnut. What is the color and thickness of the outside covering? How is this covering removed? Did you ever stain your fingers in taking the hull from a walnut? Crack a few nuts to find the kernel. This is the real seed that will grow and produce a new walnut tree.

If there are any butternuts or white walnuts in the neighborhood make a comparative study of the butternuts and walnuts.

Let the children name all of the other nut trees that they know. Select two or three for special study. Among the most interesting are the hickory and the oaks. Follow the outline suggested for the walnut in the study of these trees. A collection of various kinds of nuts and acorns will be found interesting and valuable. Plant some of the nuts in boxes or on the school grounds. Do not cover them deeply. Just a little layer of soil on top. Why is it necessary to plant the nuts in the fall? The children may know that because of the hard shells all nuts must be frozen before they can germinate.

AUTUMN ACTIVITIES.—Spend at least two lessons on an informal discussion of autumn activities. What work are the farmers doing now? What crops have already been harvested? Are any left unharvested? What are the farmers doing with the corn that they are gathering? How is it stored? How is it unloaded into the crib? Who has gathered apples this fall? Where and how have they been stored for winter use? What garden products are still left in the garden? Make a list of all the products of the neighborhood that have been marketed. How have they been taken to market? Who knows what is done with them in the town? What people are dependent on the farmers for food? What things do the farmers get in town that the farm does not produce for them.

Spend some time in having the children construct the house as suggested in the outline.

DECEMBER

OUTLINE FOR DECEMBER.—*Uses of the fire about the home, methods of heating, cooking. Use of wood, coal, gas, oil, electricity; source of each; dangers. Simple experiments to show how wood burns, coal.*

The stove, all the parts, the draft—differences in weight of cold air and warm air; dampers; chimney; experiments to detect air currents near window, door, over stove or register. Invert chalk box or cardboard box, cut small hole in bottom near each end and place candle under one hole and with smoking match or paper discover air current into the other hole.

The thermometer; how it works; different kinds—mercury and alcohol; its uses, learn to read it, room temperature and freezing point. Read thermometer in different positions in the school room—near the heat supply, farthest from it, near the window, on the door, near the ceiling, in the outer hall, etc. Daily records of outdoor temperature for two or three weeks. Difference in sunshine and shade, morning and noon. Temperature of the body.

Physiology. Why we need fresh air in our homes and at school. What makes air impure? How can we get and keep fresh air in our school room? In our sleeping rooms?

LESSON PLANS—USES OF FIRE, ETC.—Discuss the different uses of fire about the home and school. Name the different kinds of fuel used in cook stoves, in heating stoves, in furnaces. Make a comparative study of the different kinds of fuels, especially of the different kinds of coal. Can you name some kinds of fuel that are not used in your neighborhood? Why is wood not burned as much as it was years ago?

Name the parts of a cook stove. What is the draft in front for? Do you leave this open or closed when you wish fire to burn brightly? Where is the damper? Do you put it up or down when you wish a strong fire? If the draft is open below and the damper down, why does the fire roar up the chimney? (It is enough here

for the children to know that when air is warm it spreads out and becomes lighter than when it is cold. The air in the chimney is warm and light and the air on the outside of the stove is cold and heavy, hence it rushes in thru the draft and pushes the warm air upward in the chimney.)

Do you know how the oven is heated? Ask your mother about this and why it is that she keeps the damper up when she wishes to heat the oven.

If you should shut out all of the air from a stove will the fire burn? Name some of the other uses of air in the house besides this one. (Lamps need air in order that they may give us light, and we need air in order that we may live and do our work.) When the air has been breathed into our lungs and then breathed out again it is not good for us, neither will it make a fire burn brightly. Why do we need, then, to have our school room and our rooms at home arranged so that we may always get a supply of fresh air?

JANUARY

OUTLINE FOR JANUARY.—*Physiology. How we should breathe. What prevents good breathing? What happens when we breathe? What do you see in your breath on a cold morning? Effect of breathing upon the air. Why we take cold. Simple idea of germs. Danger of breathing dust. What are all the sources of dirt in our homes, in the schoolroom, on our clothes? How do we try to get rid of dirt, sweeping, dusting, scrubbing, washing, etc. Proper methods of sweeping, dusting, damp broom and cloth or oil on cloth. Vacuum cleaner.*

LESSON PLANS.—By simple experiments help the children to find out what movements take place in their bodies when they breathe. Place the hands on the chest and take a deep breath. Notice how the breast bone moves outward. Place the hands on the side, breathe deeply and note the outward movement of the ribs. Watch some one else as he breathes and notice how the shoulders are lifted upward. Where does the air that you breathe enter the body? Discuss proper methods of breathing. Why it is more hygienic to breathe thru the nostrils than thru the mouth. Study the breathing organs in your physiology. Discuss thoroly what we mean by pure air. The children should get the notion that pure air means plenty of oxygen and air that is free from all kinds of dust. They should realize that dust of various kinds is likely to carry with it disease germs that may enter our bodies thru the breathing organs.

Name all the ways in which dust may get into the air. Discuss the methods of getting rid of dust. The best methods of sweeping and cleaning.

Refer to the books on physiology for the other topics suggested in the outline.

FEBRUARY

OUTLINE FOR FEBRUARY.—*Review all previous work with reference to the senses. How we can do good work. How rest the nerves and brain. How exercise? The effect of alcohol and tobacco upon the brain and nerves.*

Winter birds. Observe food habits of any birds found in the neighborhood. Place beef suet or long bones with a little meat in trees and watch the birds that feed there.

Special Study of English Sparrow.—Where it stays, feeding, roosting, nesting, disposition. Why we do not like the English sparrow as well as our native sparrows. Study of feathers as a body covering. Use chicken feathers, find parts of a feather, different kinds, how they grow, etc. Special study of pigeon.

Physiology.—First aid to the injured. Bruises, cuts, sprains, etc.

LESSON PLANS.—Refer to the books on physiology for the topics suggested in connection with the senses.

WINTER BIRDS.—Encourage the children to keep a watch for birds during the winter months. There are a number of birds that come to us from the far north to spend the winter. There are others that stay with us during the winter. Many of these may be attracted to the school ground or about the homes by placing food for them in the yards. Procure a piece of beef suet, wrap strong twine around it many times and fasten it up in the fork of a tree or suspend it from a branch.

Chick-a-dees, nut hatches, downy and hairy woodpeckers, and blue jays will probably come to this feeding place during the cold weather. If the English sparrow is abundant in the neighborhood have the children make a special observation of this bird. What it eats. Where it stays at night. Whether it is ever found carrying material for nests during the winter months. State some reasons why we do not like the English sparrow as well as our native birds.

FIRST AID TO THE INJURED.—Discuss the various ways in which accidents are likely to occur to children. From some good physiology find out how to treat a cut, a burn, or a sprain, how to make a bandage and put it on, and various other things that should be done when one has met with an accident. The teacher should realize that the only way to make this work of value to the children is to practice doing these things. A part of the physiology time should be taken for actual practice in dressing cuts, in knowing how to carry a wounded person, in making and applying a bandage, etc.

MARCH

MARCH.—*Simple experiments with seeds and seedlings, using peas, corn, and pumpkin; grow between blotters or cloth, and in sawdust. Conditions of growth; vary the moisture, light, temperature, etc.; from sprouted peas remove as much as possible of the food supply (cotyledons) and compare with similar seedlings not so treated. Distinguish root, shoot, food supply, seed coat. Plant sweet peas, sunflowers, tomatoes, at home and school. Raise tomato plants to take home.*

Special study of woodpeckers; if possible identify the five common species; characteristics common to each; value to man. Other birds which search the tree framework for insects,—brown creeper and nut catch.

SEEDS AND SEEDLINGS. LESSON 1.—Begin the work with a short informal discussion of the duties and pleasures that come with April. What special work is done at home, in the house, in the yard? In the garden? In the fields? What new games are played at school?

Among other things the planting of seeds will be mentioned. Have children name all the seeds that we plant in April (radish, lettuce, peas, beets, oats, spring wheat, etc.) Can you think why we do not plant such seeds as corn, beans, and cucumbers this month? Some seeds like a warm seed bed. If we plant these before the soil has become warm in the spring they are likely to rot instead of grow. Besides, if they should grow, the little plants are not hardy enough to stand the frosty nights that April often brings. Ask each child to bring from home two or three seeds of various kinds that may be planted in April. An interesting chart may be arranged in this connection. Have the children stick the seeds in groups of two or three on a piece of cardboard and label neatly. Ordinary mucilage may be used for this. This may be done as seat work.

LESSON 2.—In preparation for the second lesson place a number of peas in water and allow them to stand for at least twenty-four hours. Each child should have a soaked pea and a dry one. Compare the two. How do they differ? What do you think has caused the change? (The pea has absorbed some of the water and has become swollen.) Would it do the same thing if it were placed in moist soil? Try it.

Remove the covering from the soaked seed. This is called the seed-coat. How many parts can you now see in the seed? The two thick chunky pieces are called cotyledons. Find the tiny body that holds the cotyledons together. Let us try some experiments in order to find out just what all these parts of the seed are.

Put some good soil into a tin can or flower pot. If you use a tin can, be sure to punch a hole in the bottom for drainage. Plant five peas and keep well-watered. Place two soaked seeds on some moist blotting paper or a damp cloth. From two other soaked seeds cut away as much of the cotyledons as you can without injuring the tiny body that holds them together. Place these beside the others. Now watch them carefully from day to day to see whether they all sprout and grow.

LESSON 3.—If we plant peas or other seeds in the garden we expect them to sprout and grow. Let us try to find out what conditions are necessary in order that they may do their work.

Experiment 1. Place two or three soaked seeds on some moist cloth or paper in a cup. Place the same number on dry paper in another cup. In another entirely cover the seeds with water. Set the three cups side by side in the room.

Experiment 2. Place three or four seeds on moist paper in a cup and keep the cup in a warm place. Place three or four others in another cup and keep in the coolest place you know.

LESSON 4.—Do you know any seeds that we plant in the house, and later transplant the plants to the garden? Among them are tomatoes. Why do we not plant the tomato seeds out of doors this month? (Tomato plants are very tender. A slight frost would be sure to kill them.) Why then do we not wait until May and plant the seeds out of doors as we do the beans and corn? There is a good reason for this, too. We should have to wait until the latter part of the summer or early fall to get any tomatoes to eat. So if we want tomatoes in the summer we must start the plant indoors now.

If the teacher can get a few packages of choice tomato seeds so that each child in the class may have at least two plants to take home to transplant and care for, it will add greatly to the interest of the work.

Let the children help to decide what they will need in order to raise some tomato plants at school. (They will need a small box. Perhaps some child can provide this, some good soil, and the seeds.)

LESSON 5.—Put the soil into the box and sow the seeds, covering them lightly with less than half an inch of soil. Watch for the first appearance of the plants. How long did it take the seeds to sprout? Compare with sweet pea in this respect. How many leaves has the little plant? Watch to see where the second pair of leaves appear. Are these leaves the same shape as the first ones?

LESSON 6.—A lesson on sweet peas may well follow the lesson on the common pea. How many of the children plant sweet peas at home? How many would like to plant some? Encourage the children to send for penny packages of seeds for their home gardens. If there is room a short row may be planted on the school grounds.

These plants do well anywhere in rich mellow soil, and in plenty of sunshine. They may be planted along a fence or close to a building, or out in the open garden. We must make a drill at least six inches deep, just as early as the soil is fit to work; the earlier the better. Sow the seeds in the trench and cover with about two inches of soil. When the plants have grown about two or three inches in height, fill the trench almost to the top with soil leaving a slight depression to catch water. After the soil is thoroughly soaked, fill to the top with loose soil, or place a layer of straw on the top to hold the moisture.

LESSON 7.—It is now time to find out what our experiments have to teach us.

Experiment 1. Which of the seeds have sprouted and grown best? What is your conclusion as to the effects of moisture upon the germination of seeds? The seeds that were *covered* with water did not grow because the water shut out all the air. Seeds need air in order to live just as much as animals do.

LESSON 8.—Compare the seeds that were put in a cold place with the ones that were kept warm. Is there any difference in the size of the sprouts? Which favors sprouting, warmth or cold? Now we know of at least three conditions necessary for the germination of seeds. What are they? (Warmth, moisture, and air.)

LESSON 9.—Examine some seeds that have sprouted well. Can you find the root? From what part of the seed did it grow? Can you find the shoot; that is, the stem with the tiny green leaves on it? Are the thick cotyledons still fastened to the root and shoot? Look at the seeds from which you cut the cotyledons. Have they grown as well as the others? Can you think why? (The cotyledons are little storehouses of food upon which the plant lives until it is able to make food for itself. When we use peas for food, we eat the material that was stored up for the young plant.)

Dig up one of the plants that is growing in the can or flower pot. Examine the cotyledon to see if the food is being used up. At the end of a week dig up another, and continue this till all are removed. Do the little plants use up all of the stored food?

If you have a small plot in the school yard for a garden have the children plant a few sweet peas.

WOODPECKERS. LESSON 10-15.—The aim of bird study in any of the grades is to encourage the children to form a habit of observing birds that they may learn to know and love them, as well as to help protect them. Bird study usually gives the best results when a few minutes are devoted to reports two or three times each week, rather than an entire period spent in a formal study.

Begin the work by asking how many of the children know any of the woodpeckers. The red-headed woodpecker and the flicker or yellow-hammer are common in most parts of Illinois. The downy, hairy, and sap-sucker are also found in considerable numbers. Procure some colored pictures of woodpeckers. (These may be bought at cost from the publisher of this pamphlet.)

Tell the children to watch for the yellowhammer or flicker and be ready to report the next day. Note the size of the bird. Is it larger or smaller than a robin? What colors can you see? What is the color of the spot on the back of the head? Look for the black crescent shaped spot on the breast. Note where the bird is and what it is doing. When you are sure that the children know the bird, tell them you want them to watch the flickers about their homes to see how many things they can find out about these birds. Have them note especially all the different places where the birds are seen, and what they are doing. How does the bird's flight differ from that of a robin? What marks aid in identifying it when flying? (The white spot in front of the tail and the golden yellow lining of the wings.)

At the end of a week, during which the interest has been kept up by occasional reference to the bird, have an indoor lesson. This should be a free expression of the observations made by the children. Good pictures of the bird may aid in settling some points in which there is a difference of opinion. Some points may well be left to be settled by further outdoor observations.

In the discussion of what the children have seen, new problems will certainly arise. For example, how does a flicker manage to walk up a tree trunk? The children will readily see that the short, stiff feathers aid the bird in climbing and in resting on the sides of trees and posts. By means of pictures, the teacher may bring out the special adaptations of the toes, two pointing forward and two backward, that enable the bird to cling securely to vertical surfaces.

The question of the flicker's food will come up. No doubt some of the children will report that they have seen the birds feeding while on the ground. What were they eating? The answer to this may or may not be found by observation. Some child may be fortunate enough to find a flicker sitting at an anthill eating ants. But whether the children are able to make out for themselves that flickers eat ants or not, it is well to have them know that during the summer and fall months more than two-thirds of the food of the flickers consists of ants.

When does the flicker make its nest? Some of the children will have a chance to watch the flickers digging holes in trees for their nests. What tools do they use in chipping out the wood? Their strong, chisel-like bills. Do both birds work in making the nest? Tell the children that if they have very sharp eyes they can distinguish the males from the females by looking at the side of the throat. The male has a black stripe on each side of the throat. How far from the ground are the nests made? Compare different ones. Watch the birds caring for the young. Listen for the loud hissing sound made by the young while they are still in the nest. Watch them come forth from the nest. Can they fly well? Few young birds can fly farther than young flickers. Do the parents continue to feed the young after they have left the nest? This will be easily determined since the young beg in such a noisy manner for just another bite that the children will be sure to hear them.

Have the children decide whether the flickers are of any use to us. The fact that they eat so many ants and other injurious insects places them among our most beneficial birds. Leave unanswered the problems whether flickers use the same nest year after year, and whether they stay with us all winter or go away in the fall as robins and bluebirds do. A few flickers remain here over winter. They often excavate holes in trees or buildings and remain under shelter during the nights and very cold days. On warm days they sally forth to feed upon tree borers and whatever edible thing they can find.

While a detailed study is being made of the flicker, the other woodpeckers seen by the children should come in for a share of the discussions. Even in the third and fourth grades something may be done with a simple comparative study of wood-

peckers. The children will be able to point out a few characteristics that are similar in all birds, as the hard bill, short stiff tail and feet with two toes forward and two backward. In localities where the red-headed woodpecker is abundant, it will be found fully as good for a detailed study as the flicker.

CORRELATION WITH LANGUAGE.—The experiments and studies in this month's work offer excellent material for the language work suggested in the Course of Study for the seventh month.

Use *good* and *well* in the sentences that describe some of the results of the seed experiments, such as "A cool temperature is not good for sprouting seeds." "The dry seeds did not sprout well," etc.

For the composition, use any of the topics suggested by the work, as, "How we found out what seeds need to make them sprout and grow." "How we planted tomato seeds." "What we have found out about woodpeckers."

APRIL AND MAY

OUTLINE FOR APRIL AND MAY.—*Care of sweet peas and tomatoes.. Encourage home and school flower gardens. Discuss preparation of soil. Try to have each child plant a small garden of his own at home. Talk about the display of flowers and vegetables that will take place next September. Plant tomatoes, sweet corn, aster, phlox, touch-me-not, sunflower.*

HOUSE BUILDING.—If possible follow the building of a house in the neighborhood; materials used, source of each—stone, brick, cement, lumber, nails, hardware, etc. Different workmen engaged—architect, mason, carpenter, plumber, tinner, electrician, painter—or different processes if done by fewer men. Plan of the house; identify rooms and parts—joists, studding, rafters, sills.. Uses of hardwood and softwood;; methods of "finishing woods."

VACATION PLANS.—Discuss methods of caring for sweet peas, cutting flowers, saving seed, etc. Similar plans for tomato and other plants. Continue observation of birds around the home.

SWEET PEAS AND TOMATOES. LESSON 1.—If sweet peas or common peas have been planted at school, the study of the growing plant will be found interesting. If the children planted seeds at home, then have reports from a study of the home plant. How high are the plants? Have some grown faster than others? Are the stems strong or weak? Can they stand erect without supports? (Stems of peas grow rapidly, but they cannot stand alone because they have taken on the habit of climbing.) Have the children decide what supports they may use for their sweet peas. (They may use strings, sticks from a brush pile, or strands of wire.) Do all common peas need supports as well as sweet peas? Have the children look at the peas in the home garden and report. (Some of the early peas that grow about a foot high are called dwarf peas. These do not climb.)

LESSON 2.—How do the peas climb? (The little string-like bodies that curl around the support are called the tendrils.) How do the tendrils take hold of the support? Do they all curl in the same direction? On what part of the plant are the tendrils situated? How many can you find on one plant? Can you find any other plants at home that climb by means of tendrils?

LESSON 3.—Have the children recall how they planted the tomato seeds and how the little plants started to grow. How high are the plants now? If they are two inches high they are ready to transplant into small flower pots, berry boxes, or tin cans. If the cans are used be sure that a hole is made in the bottom of each for drainage. In transplanting be careful to take up a little soil with the roots. Have the can about two-thirds full of good rich soil. Hold the little plant in the middle of the can with the roots resting on the soil. Now fill the space around the roots with more soil and press the soil closely around the plant with your thumbs. Water and keep out of a strong light for two days.

LESSON 4.—Discuss how the tomato plants should be set out in the garden. This should be done the first or second week in May. They should be set in rows three or four feet apart. Use the same care in setting out the plants in the garden that you did in transplanting into the cans. If plants have been grown at school, give each child one to take home and set out in the home garden.

BUILDING A HOUSE. LESSON 5.—Begin the work by asking the children how many of them have ever seen a house in process of building. Perhaps some members of the class have had a new home built recently; if so, they will be able to contribute largely to the discussion. What is the first thing to do in building a house? (The cellar or basement is dug.) Who has seen this done? (Usually horses are hitched to scrapers and the dirt is scraped up and hauled off to one side.) When most of the dirt is taken out in this way, men with spades shave down the sides, making the dirt walls very smooth and even. What is the next thing to do? (The foundation must be made.)

LESSON 6.—What materials are used in making the foundation of a house? (Tell the children to find out what the foundations of their houses at home are made of. Some will find bricks, some cement blocks, and some stones.) What is used in the foundation of the school house? How are the bricks held together? Who knows out of what mortar is made? (Sand and lime or cement are mixed with water to make mortar.) What is a man called whose business it is to build walls and chimneys out of bricks or stones? (He is called a mason.)

LESSON 7.—After the foundation is made, who then carries on the work of building the house? Where do we get the lumber that the carpenter uses? Talk about some of the different pieces of lumber that are used for various parts of the house. What are the walls made of? Look on the inside of the school room. What can you see? Look on the outside of the building. How are the weatherboards put on? Sometimes these boards are called siding. Is there anything between the siding and the wall on the inside? (Just under the siding is another layer of boards that fit closely together as the boards in a floor do.) Who knows the name of this layer? It is called sheathing. What are the sheathing and the siding nailed to? Look on the outside for the nail heads. Are the nails in rows? How far apart are the rows? The nails tell you where the upright pieces called studding are placed. Each piece of studding is two by four inches, and is placed upon the sill which rests upon the foundation. The studding extends up to the roof.

LESSON 8.—Who knows what is nailed to the studding on the inside? Some of the children may have seen the lathes that are put on to hold the plaster. What other part of the house do you know besides the foundation and the walls? (The roof.) What is the roof made of? How are the shingles put on? Examine a shingle. Why is it thicker at one end than at the other? What are the shingles nailed to? They are nailed to boards that rest upon the rafters. If you have an attic you can see the rafters extending upward and meeting in the middle of the roof. Another part of the house is the floor. The pieces to which the floor is nailed are the joists. You can see the joists in a cellar or basement.

LESSON 9.—There are many more parts to a house that a carpenter must know. Look around the school room and let us make a list of the things that we see. We can find the ceiling, walls, floor, doors, and windows. If you stand in an open door the piece directly over your head is the lintel of the door. The side pieces that the lintel rests upon are the jambs. The frame that the carpenter put all around the doors and windows forms the facings. The lower part of the window that we often call the sill is the window stool. The sill is the lower part on the outside. The part of the window that holds the panes of glass is the sash.

LESSON 10.—Sum up the work by having the children name all the different materials that are used in making a house, and all the different workmen that help to build it.

VACATION PLANS. LESSONS 11-13.—Before the school closes a few suggestions may be made for some observations and studies during the summer vacation.

SWEET PEAS.—Watch the growth of the plants. Are they slow or rapid growers? When do the first flowers appear? We must learn how to remove the flowers without injuring the plants. We must cut them with a pair of scissors, not pull them off. Cut the stems as long as possible. It is very necessary that you keep the flowers cut if you wish to have an abundance of flowers all summer. The sweet-pea flower is a good one to study. The children may be interested to know that it is called a butterfly flower. The two large petals at the sides are called the wings, the one at the top the banner or standard, and the two that are grown together forming a little boat are called the keel. Notice the pods. See if you can find the part of the flower that makes the pod. Do you ever find any insects on the flowers?

TOMATO.—Watch the growth of the plant and note when the first blossoms appear. What is the color of the tomato flowers? When does the fruit begin to ripen? Can the plants stand up straight when they are loaded with fruit? It will be a good plan to use a support to help keep the fruit up in the light and air so it will ripen more evenly. How many tomatoes will one plant produce? What is the fruit good for? Think of all the different dishes made from tomatoes; stews, soups, cream tomatoes, salads, scallops, etc. How are tomatoes put away for winter use? Our mothers can them, or they are canned in the factories and we may buy them from the grocer.

BIRDS.—Encourage the children to watch the woodpeckers and other birds during the summer. Where do they build their nests? Do the mother and father birds feed the young birds after they leave the nest? How do the young birds differ from the old birds? If the children will place pans of water in the yards in the shade of trees and shrubs the birds will come to drink and bathe.

CORRELATION WITH LANGUAGE.—The teacher will find abundant material in these nature-study lessons for the use of *them* and *those*. Those windows are large. Those birds I saw yesterday are flickers. I saw them on the ground, etc. Compositions may be written upon, "How I take care of my sweet peas," "How I should build my house," etc.

LESSON PLANS FOR FOURTH YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER—GARDEN.—*Follow up any garden work started the spring before. Discuss work done in the garden during the summer. Special study of sweet corn; character of plant, stalk, leaves, tassel, number of ears. Compare with pop corn. Uses, canning factory. Make list of kinds of corn.*

SUNFLOWER HEAD; Identify small florets, quantity of seed raised by one plant, uses of seeds, for birds, poultry. Uses of stalks for fuel. Find other plants of same flowering habit, asters, cosmos, marigold, thistle, rosin weed, etc.

INSECTS.—The house fly as a pest. Habits of moving, feeding, life history; how flies carry disease; how to get rid of them. Children try different methods of killing them, traps, fly paper, etc. How do flies spend the winter?

TOMATO WORM.—Food, habits, enemies. Make plans for Harvest Home exhibit.

GARDEN.—Discuss the work done by the children in the garden during the spring and summer. Who have gardens of their own? Who will have some flowers or vegetables to display in the Harvest Home Festival at the end of the month?

SWEET CORN.—Study the entire plant. How high does sweet corn grow? Does one stalk bear more than one ear? Compare with field corn in height and number of ears. Study the ear. Compare with an ear of field corn. What are the differences you see? How does the grain differ from that of field corn? From pop corn? Put some of the crinkled dry grains into water and let them remain over night. What change takes place? What are the uses of sweet corn? Why do we like it better than field corn? (It has much more sugar in it.) Discuss the canning of sweet corn. Who has visited a canning factory? Tell all the things that must be done with the corn from the time it is brought into the factory until it is in the cans ready to ship all over the country.

SUNFLOWER.—Make a study of the entire plant. Note height of stem, thickness, size of leaves. Are there any branches? Where is the head borne? If possible have a sunflower head in the class. Have the children look at it carefully and decide whether it is one flower or many small flowers. One small flower is called a floret. Look at it carefully and find that each floret produces one seed. Note the number of seeds in one head. Which seeds ripen first? Color of ripe seeds? Discuss the uses of the seeds. Who has seen birds eating the seeds? Who feeds them to chickens? (Chickens are very fond of sunflower seeds). Break open a stalk. What is on the inside? Who has ever used sunflower stems for kindling? (In some western states where fuel is scarce sunflowers are raised for this purpose.)

INSECTS.—House fly. Is the house fly numerous at this season? Name all the places where the flies are found. Are there any in the school room? Study the movements of the fly. How does it get around? Find out how many feet one fly has, how many wings. Look on the head for its eyes. Can it see well? (Its eyes are so large that its range of vision is very good.) How do flies eat? Watch one lapping up food with its tongue. What do flies eat? Discuss how flies carry tiny germs of typhoid fever upon the hairs of their feet or bodies. If a fly visits material from a sick room in which some one has typhoid fever it may get some of the germs upon its feet and then fly away. It may come into our homes and alight upon some food and perhaps the germs may fall off. If we eat the food with the germs upon it we may take the typhoid fever.

Discuss how we may get rid of flies. Have the children try various methods of trapping and killing these pests.

OCTOBER

OUTLINE FOR OCTOBER—SPIDERS.—*Habits of moving, catching prey, feeding, hiding. Webs, how made, different kinds. Value of spiders in catching flies. Different kinds.*

HOME MAKING INSECTS.—Bees, wasps, ants, where they make their homes, food value to man. List of flowers that bees like to visit. Story of how honey is made, the comb. Watch for flying ants, capture some and keep in bottles for study. Start ant colony.

BULBS.—Study of tulip bulb. Plant a tulip bed out of doors. Forcing bulbs.

SPIDERS.—Give the children some observation work to carry on outside of school to report next day. Notice in what different places spiders are found, what are they doing? Where webs are thus found? How do webs differ from one another? Touch different parts of a round web and note what happens. Why does part of the web stick to your fingers? (The web has a sticky secretion on it that holds flies and other insects fast in the web.)

Look for different kinds of webs, round ones, flat ones. Look for webs fastened to grasses, trees, etc. These are made by spiders that swing out upon thread like kites and fly thru the air. How many legs has a spider? What do spiders eat? (They feed upon flies and other insects and are to be considered as our friends rather than our foes.)

HOME MAKING INSECTS.—Make a detailed study of the honey bee. Find bees feeding upon the grapes or other fruit. Put one into a jelly glass or wide mouth bottle. Put the stopper in and the children will be able to study the bee thru the glass. Let the children find out all they can about the different parts of the bee.

Discuss the homes of honey bees. Who have ever seen a bee hive? Describe it. What flowers do bees like to visit? What do bees gather from the flowers? (Two things, nectar, a sweet juice from which they make honey, and pollen from which they make bee-bread. Look for wasp nests and make a study of these—especially mud daubers and paper wasps.

BULB GARDENING.—Every rural and village school should have a bulb garden, even though a small one. Bulbs are easily grown, and they give results before the schools close in the spring, which is an additional reason for growing them. For schools, tulips are most satisfactory. Narcissus, daffodils, and crocuses are also good. As a rule children prefer the tulip.

While the special study of bulbs is planned for the third and fourth year it is suggested that the entire school participate in planting the bulbs.

LESSON 1.—Discuss with the children where the bulbs should be planted. Let them help to decide. If there is a fence around the yard a bulb garden a few feet wide in front of the back or side fence gives a good effect. A small bed may be placed in the corner of the yard, or near the coal shed, or even at the corner of the school building. Care should be taken, however, not to plant the bulbs where the rains will drip from the roofs upon the bed. Spend a little time discussing with the children the arrangement of the beds with regard to color. Is it a good plan to have several colors mixed promiscuously in one bed? Here is a chance to help the children gain some idea of harmony of color. An entire red bed, or a pink one, or either with a white border gives a very pleasing and artistic effect, much prettier than if all are mixed together in one bed.

LESSON 2.—For this reason the teacher should have several different kinds of bulbs if possible, and each child should have a bulb in hand. Compare the bulbs as to size, shape, and color. Notice the papery covering of the tulip bulb. What does this bulb resemble? (The children will readily see its resemblance to the onion.) If we should cut this open we should see that it is also like the onion on the inside. Have the children determine which end of the bulb will produce roots and which the shoot. What is a bulb? (A bulb is an underground stem with many thickened leaves growing closely around it.) Look for little bulbs fastened to the large one. These are called bulblets. If these bulblets are planted they will not produce blossoms for two years.

LESSONS 3 and 4.—How shall we plant the bulbs? They require rich, mellow soil. If you have a heavy clay soil let some of the older pupils suggest how it may be made more mellow. (This may be done by mixing with it some decaying vegetable matter. Nothing is better than well-rotted material from around barns.) Let the pupils prepare beds for the bulbs. Throw out the top soil to the depth of six or eight inches. If a fertilizer is to be used put it in to the depth of two inches and mix it thoroughly with the soil. Now throw back some of the top soil. Set the bulbs in this

about eight inches apart. Each child should plant at least one bulb. Now throw in the rest of the soil so that the bulbs will be covered about six or eight inches. The bulbs may be planted in another way. Prepare the bed as before, putting back all of the soil, then rake it until it is in fine condition. Cut off about nine inches from the upper part of an old spade handle and sharpen this, or you may sharpen any round, hard stick. This instrument is called a dibble. With this you may make holes in the bed. Drop the bulbs into the holes, and cover with the soil. (It is suggested that this work may be done on a Friday afternoon.) Bulbs may be obtained from any florist. Tulip bulbs may be purchased as low as twenty cents a dozen.

LESSON 5.—What do you expect the bulbs to do this fall? (The children may not be able to give any definite answer to this.) Ask them where the ground is warmer this time of the year, six inches below the surface or near the top? Which part of the plant will be likely to grow first? What we want the plant to do is to make a good root growth this fall. Why do we not want the upper part of the bulb to grow until spring? (If it should grow this fall we should have a weak plant with a very small flower.) We want the roots to get a good start this fall for only bulbs with good roots will produce beautiful flowers next spring.

LESSON 6.—Do we need to take any care of our bulb bed this fall? We must do one more thing. When the top layer of soil is frozen hard we must cover our bulb bed. What shall we use for the covering? Let the children suggest various things. (Straw, leaves, or corn stalks may be used for this.) The covering should be from four to six inches deep. Why do we do this? (It is to keep the temperature even so that the ground will not thaw out on a warm day in the winter and then freeze again. In the early spring will the ground under the straw thaw out as early as the uncovered soil? Will this keep the plants from starting to grow early in the spring if the weather is very warm? This is just what we want. If the bulb beds were left uncovered the hot days would start the plants to growing so rapidly that they would probably be dwarfed by the later frosts.

LESSON 7.—There is another method of planting bulbs that may be practiced in any school. This is the forcing of bulbs for winter blooming in doors. Any kind of bulbs that are planted out of doors serve equally well for forcing. Some of the best are tulips and hyacinths. The bulbs used for forcing, however, must be of a larger and better quality, hence they are a little more expensive than those used for outside bedding. Good garden soil will do for forcing. A little sand and good fertilizer may be mixed with the soil. Have the children bring flower pots or tin cans in which to place the bulbs. Be sure to place drains in the bottom of pots or cans. Fill the pot a little over half full of soil then set in the bulb. Now put in more soil till the top of the bub is just below the surface. If you have a large pot or tin pail several bulbs may be planted together. After planting, water until you are certain that all the soil is thoroughly moistened.

LESSONS 8 and 9.—What do we want these bulbs to do first? Just what we wish them to do in the beds out of doors—grow roots. In order to do this we must put them in a cool, dark place. We call this forcing the roots. We may place the pots in a cool cellar and cover them up with a heavy box or other object. They may be placed in a shallow hole in the ground and covered with three or four inches of soil or ashes, or they may be set on the ground along the north side of the coal shed or other buildings and covered up with soil or ashes. They should be left in the cool, dark place at least six weeks. They may be left much longer and brought in one or two at a time as desired. Encourage the children to start bulbs at home using the cellar in which to keep the pots. (Although the lesson in connection with bringing in the bulbs must come many weeks later, we shall continue the suggestions here). When the pots are brought in it may be well to remove one bulb from the soil so that the children may see just what has taken place. From what point do the roots start? Are there many roots? How long are they? Has the shoot started to grow? What color is it? Could the roots and shoot grow without food? Where do they get the food to live upon? A little discussion will bring out the fact that the food was stored up in the thick bulb and was used for the growth of the plant.

When first brought in the pots should be kept in the coolest part of the room and covered from intense light. If the school room has an entry or hall that is not kept as warm as the main room this will be a good place in which to keep the plant for a few days. After that bring them into the room where they may have plenty of

light and heat and where the development of the leaves and flowers may be watched.

There is another way in which bulbs may be grown in the schoolroom with less trouble. Procure a glass dish, rather wide. Place a number of small stones in this and fill with water. Place a bulb of the Chinese Sacred Lily or paper white Narcissus among the stones, supporting it with the bits of rock and pebbles. The bulbs will develop and open up their beautiful blossoms in about six weeks. (It is better not to keep the bulbs in a strong light or heat for the first week or two.)

NOVEMBER

OUTLINE FOR NOVEMBER.—*Wild mammals of Illinois; habitat, habits, foods, methods of trapping, uses and values of furs; methods of exterminating harmful mammals; distinguish gnawers and flesh-eaters; government experiments in breeding fox, deer, etc.*

Barnyard fowls; kinds, habits, uses and values of each. Special study of the turkey, in connection with Thanksgiving; origin of domesticated form; peculiar traits, care, Thanksgiving market.

WILD MAMMALS.—LESSON 10.—Today we are going to talk about wild mammals of Illinois. Who knows what we mean by wild mammals? (They are animals that are usually called wild animals. All mammals that we know have four feet, and are covered with hair, fur, or wool). Name some of the mammals that we have about our homes. The children will, of course, name most of our domestic animals as the horse, cow, etc. Have any of you ever seen any wild mammals in this part of Illinois? (The children should name at least the rabbit, squirrel, ground squirrel, gopher, mink, skunk. An informal discussion should follow in which the children may tell something about each of these little animals.)

LESSON 11.—Of all the wild mammals which one is most common in your district? We shall study the rabbit as a type of these little animals. Who has seen rabbits this fall anywhere in the neighborhood? Encourage the children to watch for rabbits and find out more about their habits. Where do rabbits live? The children may be ready to name the various places in which they have seen these little animals. Do rabbits move about much during the day time? When a dog is chasing a rabbit what does it try to do? Who has seen it trying to seek a place of shelter; such as a brush pile, corn crib, shed etc? Has any one ever seen a rabbit in a burrow in the ground? (Years ago probably most of the rabbits burrowed in the ground, now they find other places in which to hide. Sometimes many rabbits live together in one burrow. Each may have its own separate opening into the burrow but the underground homes are all united.) What kind of a covering has the rabbit? What is the color of the fur? Is it the same color on the back and under part? Is the fur long or short? How can you identify a rabbit when it is running at some distance from you? (The white tail.) What kind of ears has the rabbit? Did you ever notice a rabbit's foot? Which do you think it resembles more, the foot of a dog or a cat? Do you know whether the front and hind legs are the same length? What kind of a track does a rabbit make in the snow? If the children cannot answer this leave it as a problem to be settled later in the winter by actual observation.

LESSON 12.—What do rabbits eat? Let the children name various things they have seen rabbits eating. Who has ever had a pet rabbit? Upon what was it fed? What do rabbits feed upon in the winter time when the grass and clover are dead? (Many rabbits are forced to eat the bark of young trees and shrubs during the winter months. They will eat berries if they can find them, and sometimes under the brown grass they find some green leaves of clover or other plants.) Who has ever seen any young rabbits? Where were they? How does the mother rabbit prepare a nice warm bed for her young? (Some of the children may have been fortunate enough to find a rabbit's nest and may be able to tell that it was lined with leaves and soft hair. This hair was taken from the mother's own body. Do rabbits have any enemies? The children will, of course, name the dog and cat, the hawk and owl, fox, mink and weasel. Perhaps the most important enemy is man.) Is the rabbit of any use to man? Many people use the meat of the rabbit for food during the winter months.

Do rabbits have any way of defending themselves against their enemies? Are they rapid runners? Did you ever notice how a rabbit dodges or runs in a zigzag fashion often getting out of the way of a dog that is chasing it? Another way in

which rabbits protect themselves is by means of their color. They resemble closely the dead grass or brown soil. They often crouch down keeping perfectly quiet and looking so much like a piece of clod or a clump of grass that their enemies may pass them by without seeing them.

LESSON 13.—In a locality where tree squirrels are abundant, they may be used instead of the rabbit for special study. The same questions and topics may be used, modifying them of course, to fit the squirrel. In any locality a comparative lesson between the squirrel and rabbit may be worth while, noting the differences in their habits, their homes, what they eat, and how they move about.

LESSON 14.—How many children know the little striped squirrel? (This is sometimes incorrectly called a gopher. The true gopher is a larger animal and does not have stripes.) Where does the ground squirrel live? Most of the boys probably have seen a burrow of the ground squirrel and have poured water down the hole in order to "drown out" the squirrel. The burrow usually descends almost straight downward for two or three feet and then runs out horizontally sometimes a number of feet. What does the ground squirrel eat? (It feeds upon grains, berries, and leaves of various plants. It sometimes is quite destructive to corn crops because it digs up the grains after they are planted and eats them or carries them off to its burrow. Sometimes the ground squirrel gathers great numbers of half ripe strawberries, collects them into little piles, eats a few and leaves the rest.) How does a ground squirrel act when it is frightened? Did you ever see one stand up on its hind legs, stiffen and remain perfectly still, so still that it looks like a small stick or bit of brown grass? (It often remains in that position a number of minutes until its enemy has disappeared or comes so near that it is forced to run.)

LESSON 15.—What kind of teeth has the ground squirrel? The children may have observed the teeth of this little animal or of other squirrels and have noticed that the front teeth are very long and sharp almost like small chisels. Can you think of other animals that have the same kind of teeth? The children will be almost certain to name rats and mice, minks and others. All these animals are known as gnawers because they have sharp, gnawing teeth. Let the children name various ways in which these sharp, gnawing teeth serve the little animals.

Besides the gnawers we have a few other wild mammals in Illinois. Can any one think what they are? (In some localities there are still a few foxes and stray wolves and a few raccoons.) Years ago when our fathers and grandfathers settled in Illinois these animals were very common. Sometimes large packs of wolves came near the pioneer's home, barking something as dogs bark. Sometimes foxes came to the poultry yard and carried off some of the chickens and more often than now minks and weasels made raids upon the poultry yards destroying many of the chickens and other poultry in a single night. Why do we not have as many of these animals with us now? Let the children think of the conditions that have helped to lessen the numbers of these wild animals. Among other things the breaking up of swamps and the cutting down of trees have left no places for them to build their homes and rear their young. Then in the early years many of these animals were killed either for food or for the fur or simply because they annoyed the settlers so that in some places they were almost exterminated.

LESSON 16.—Who can think of some uses made of some of these wild animals? For this lesson it will be worth while to have a number of pieces of fur of various kinds in the class. Let the children examine the fur noting the softness of the hair. Are the hairs of the same length? Same color? What uses are made of the fur of animals? The children will name the making of hats and caps, collars, capes, etc.

BARNYARD FOWLS.—LESSON 17.—Let the children name all the barnyard fowls they have at home. Let some one pass to the board and write the list as the children name them. What is the purpose of raising the different fowls? How many have turkeys? Who can think of a good reason for studying the turkey in November? Have the children recall the story of the Pilgrim Fathers and the first Thanksgiving when the wild turkeys of New England were served at the first Thanksgiving feast. How do turkeys compare with chickens as to size? What is the color of the turkey? Who has any white or buff turkeys? How many have bronze turkeys? How does the gobbler differ from the turkey hen in appearance? What do turkeys eat? Where do they roost? How many have ever noticed that they prefer to roost high up in trees or on tops of buildings? Where do the mother turkeys like to

take the young during the summer months? Can you think why turkeys are more wild than chickens or other domestic fowls? This is probably due to the fact that they have not been domesticated very long. All our turkeys are descended from the wild turkeys of America. The early explorers took the wild turkeys into Europe. They were domesticated there and some of the tame ones were brought back to America. But even here in Illinois the early settlers found many wild turkeys. They are now probably all gone. Let the children tell why they have disappeared. Our beautiful bronze turkey is very closely related to the wild turkeys of Illinois.

DECEMBER

OUTLINE FOR DECEMBER.—*The human teeth, anticipated in study of mammals; kinds, structure, care; longitudinal section of tooth prepared on grindstone, to show pulp cavity; temporary and permanent teeth; the work of the dentist; effect of bad teeth upon health.*

Since the work for this month is along lines of hygiene and physiology we shall make no attempt to write out lessons in detail. In every school the teacher and perhaps the pupils have textbooks in physiology. These may be used for reference in this work. The chief purpose of this study should be to encourage the children to observe the proper rules and activities that lead to good health. Hygiene and physiology are taught to the lower grade children, not that the children may learn some facts about their bodies, but that they may learn how to care for their bodies to the end that they may be strong, healthy boys and girls.

The study of wild mammals in November gives a foundation for the discussion of teeth in December. Review the kinds of teeth that we studied in connection with gnawers and carnivorous animals. Tell the children to observe their own teeth at home in their mirrors and to find out exactly how many they have in each jaw. Note whether they are all the same shape and size. Consult the physiologies to get the names of the different kinds of teeth. To study the structure of a tooth the teacher should get a few teeth from her dentist. (These should be thoroughly sterilized before they are given to the children for study.) If some of the pupils have a grindstone at home have them grind off the entire side of two or three teeth. The children will then be able to find all parts of the teeth and how these compare with each other in hardness, etc. Here again, consult the physiology to get the names of the different parts.

Who has had the toothache? Why does a tooth ache? Examine some of the teeth that show cavities. What is in the center or pulp of the tooth that causes pain?

Spend some time in studying how to care for the teeth. Encourage the children to examine their teeth to see whether or not any of them are beginning to show decay. Sometimes partially decayed food settles close to the gums at the base of the teeth and causes a gum disease. This is quite common even among children. How shall we help to keep our teeth from decaying? How should teeth be cleaned? How often? Encourage children to use tooth brushes. They should be used after each meal and always before going to bed at night. All particles of food should be removed from the teeth. These ferment and are likely to cause decay. Decaying teeth cause bad breath, form a lodging place for germs of many diseases, prevent the proper chewing of food and thus cause indigestion. Children with poor teeth are likely not to be as healthy as those with well cared for teeth.

What is the work of the dentist? Some people think a dentist's only business is to extract aching teeth. His chief work, however, should be to help care for the teeth in such a way that there will be none to pull. Every one should consult a dentist at least once a year and have him examine the teeth, clean them if necessary, and fill small cavities that may be just starting. In every way possible impress upon the children that they cannot have strong, well bodies and at the same time a number of decaying teeth in their mouths.

Discuss the use of teeth. Why should food be chewed? If the teacher and children bring lunches to school the teacher has an excellent opportunity to help the children form good habits of eating. Let the lunch time be a pleasant social hour in which all sit down together and eat their lunches. Simple lessons may be given in a tactful way that will be of the greatest value to the children in forming proper habits of eating. Occasionally it might be worth while to have some of the children serve the others. Discourage the habit that so many country children have of eating their lunches a piece at a time while they are running and playing.

JANUARY

OUTLINE FOR JANUARY.—*Evergreen trees; identification of different kinds; habits of growth; shedding of leaves; cones; seeds; uses of each kind.*

Muscles; uses; movements; simple survey of structure; fibers; connective tissue.

LESSON 1.—Trees. Let the first lesson be a discussion of trees that have dropped their leaves. Look at the trees in the schoolyard and at home. Can you see the real forms of the trees now better than before the leaves were gone? Have they many twigs? Look at several different kinds of trees and compare them in this respect. Is the bark of the different trees the same color? Observe the trees of the same kind to see if they are similar in branching, in kinds of twigs, and color of the bark. Look at these leafless trees until you see how beautiful they are with their smooth branches and graceful twigs against the winter sky. Can you find any buds on the twigs ready for the spring opening?

LESSON 2.—Evergreens. Choose for study any evergreen in the neighborhood. There are several different kinds of evergreens that may be found in any neighborhood in Illinois. In some places you will find different kinds of pines. The pines are evergreens that have long needles. There are three kinds that you are likely to find. The white pine has five long slender needles clustered together in a short sheath. The Scotch pine has two stiff needles in a cluster. The Austrian pine, also, has two needles but they are very much longer and stiffer than those of the Scotch pine. Usually the needles of this pine are two to four inches in length. You can distinguish the Scotch pine from the Austrian by the color of the bark. The upper part of the trunk and the branches are yellowish red. The Austrian is dark gray all the way up.

In some places you will find the Norway spruce. The needles of this tree are short—not more than an inch in length. They are stiff and sharp pointed and are arranged singly on the twig. They are found scattered on all parts of the twig, upper and lower part as well as the sides.

The hemlock looks something like the spruce. The needles are about the same length but they are arranged regularly on two sides of the twig, making the twig appear flat on the top. The under sides of the needles are white.

The balsam fir is another short needled evergreen. Its needles are arranged somewhat as they are on the Norway spruce, but the twigs are somewhat flatter, the needles are silvery on the under side, while the spruce leaves are green on all sides. If you have difficulty in determining by the leaves whether the tree is a fir or a spruce look at the trunk of the tree. If it is a fir you will find scattered all over the trunk good sized blisters. Press on one of these blisters hard enough to break the skin and drops of resin will come out. The fir is the only one of our evergreen trees that has resin blisters.

Another evergreen that is very common in many parts of Illinois is the arbor vitae. This is sometimes called the white cedar. This tree does not have needles at all, but flat scale like leaves that overlap each other forming a flat twig.

One more tree may be found and that is the red cedar. Here also you will find the scale like leaves but they are stiff and pointed and more like awls than those of the arbor vitae. The red cedar belongs to the juniper group of evergreens,

Have the children try to identify the different evergreen trees that they may find in the district. Have them look at the trees to notice the habit of branching. Can you trace the main stem of the tree from the foot to the top? Is there any regularity in the method of branching? Stand under the tree close to the trunk and look up. Are there many small branches or leaves near the trunk?

LESSON 3.—For this lesson the children should have in the schoolroom a few twigs of the tree that you are to study as a type. Let us suppose it is the white pine. Look at the leaves. What shape are they? How long are they? Do they vary in length on different parts of the twig? Are they arranged singly or in clusters? How many in one cluster? How are the clusters fastened together? (Note the little sheath that grows around the base of the cluster of needles. In the white pine you always find five needles in the cluster.) Look carefully at your twig to determine how many years' growth it represents. (You can tell this by a slight joint in the twig. In most of the pines you will find branches starting out at each years' growth.) How many inches did the twigs grow last year? Does the growth vary from year to year?

LESSONS 4 AND 5.—Do you find leaves on last year's growth? On the part that is two years old? On the three-year-old twig? Are the leaves as numerous on

the two-year-old twig as they are on the one-year-old? Are there any leaves on the four-year-old portion of the branch? (You rarely find leaves on the pines that are four years old.)

Do the evergreens shed their leaves? Look at the old portions of the twigs for scars showing where the leaves have fallen. Do you find any leaves that are brown and dead still clinging to the twigs? How do these trees differ from the deciduous trees in the method of dropping their leaves? (By deciduous trees we mean trees such as the elms and maples that drop their leaves each year. The main difference between the evergreens and the other trees is that they retain their leaves longer and instead of dropping them all at once drop them a few at a time.) Look on the ground under the evergreen trees. Do you find any evidence that these trees drop their leaves? Watch for the dropping of the leaves this winter. You will often find many of them flying over the snow after a heavy snow storm.

LESSON 6.—Cones and seeds.—For this lesson have some twigs in the class with cones on. Also some of the old cones that have been picked up from the ground. Do you find cones of different sizes on the twigs? Where are the cones attached to the twigs? (You may find some very small ones near the end of last year's growth, larger ones on the two-year-old twigs.) What is the shape of the cone? How long is it? Do the old cones of the same tree vary in length? Are the scales large or small? Are they close together or rather loose? Look carefully at the base of the scales for some seeds that may still be left in the cones. How large are the seeds? Have they any special adaptation for getting away from the parent tree? (If the cones are not too old you probably can find a few of the winged seeds left in the scales near the base of the cone.)

The small cone that you find near the end of the twig was formed last spring. It will grow and produce seeds next year. So you see it takes the white pine two years to mature its cones and seeds. This is true also of the other pines, the Austrian and Scotch. Perhaps you may find some cones of these trees that have not yet shed their seeds. The scales of these are tightly closed. If you find some lay them up in a dry place in the schoolroom or at home and you may have the pleasure of hearing the scales snap as they open and throw out the seeds.

LESSON 7.—If you have studied the white pine as a type then give one or two lessons to a comparative study of the other pines if there are any in the neighborhood. Note the differences and resemblances till you are certain you can tell the different kinds apart wherever you see them.

LESSONS 8 AND 9.—Choose one of the short needled evergreens, either the spruce, fir, or hemlock for a type study as you did the pine. Study the arrangement of the leaves; their length. How many sides has each needle? Find the age of the oldest leaves by making out the year's growth as you did for the pine. You will find that some of the leaves on the Norway spruce are seven or eight years old. The spruces retain their leaves much longer than the pines. Study the cones, if you can find any, and compare them with those of the pine as to shape and size. The cones of the Norway spruce are reddish brown, several inches long, very shiny and pretty. Compare the hemlock and fir with the spruce.

LESSONS 10 AND 11.—Have one lesson on the arbor vitae. Who has seen hedges made of this evergreen? They are used in some places very largely for hedges around gardens and yards and are very pretty if kept trimmed properly. There are many different varieties of arbor vitae. Some of them are low shrubs but others grow into most magnificent trees. Notice the habit of branching. Find the oldest leaves. You may find a few that are three or four years old, but most of the fresh green ones you will find on the one-year and two-year twigs. The cones are so tiny you will need to look closely to find them.

If there are red cedars in the district compare these with the arbor vitae. Some red cedars may be found growing wild on rocky bluffs along some of the rivers of our own state.

LESSON 12.—Have the children tell why they like evergreen trees. Which kind do they like best? Of all the evergreens that we have the white pine is by far the most beautiful tree. Discuss the uses of the various kinds of evergreen trees. Your geographies may tell you something about the places where the evergreens grow in great numbers. The white pine is perhaps the most important of all

our pine trees. You will find it in Eastern United States and in the region of the Great Lakes. So important has this been for making lumber that most of our best white pine trees have been cut down and been used. Steps are being taken to renew the forests of white pines in Maine and some of the states along the Great Lakes.

The yellow pine, which you do not find growing in Illinois at all even as an ornamental tree, grows in the South. It is at present one of the most important pines for the making of lumber. We sometimes call it hard pine. The red pine which grows far to the north is also an important tree in the making of lumber.

The Norway spruce, as its name indicates, is a native of Europe. We use it here as an ornamental tree. In Europe its lumber is used very largely for building purposes and for the making of furniture.

The bark of the hemlock is used in tanning leather. It is usually mixed with oak bark and the combination makes the very best kind of leather that we have.

The red cedar is sometimes called "pencil cedar" because its wood is used so extensively in the manufacture of lead pencils.

LESSON 13.—Muscles. Discuss with the children what enables us to move about? Let them think of their bodies as living machines that move and do work of various kinds. It is the muscles, with the aid of the bones that make any movement or motion possible. Place your right hand on your left arm above the elbow and grasp it tightly. Now lift a book from the desk and raise it toward your head. Can you feel your arm muscles moving as you lift the book? Place your hand on your sides and note the movements of the muscles as you take a deep breath. Find other muscles that move as you do various things. Look in the physiology for a picture of the muscles of the body and study how they are arranged.

LESSON 14.—Besides the muscles of our arms, legs, shoulders, chest, that move the parts of the body that you can see and control can you think of other muscles that move parts of the body that you cannot see? Among these have the children think of the heart, which is made mostly of muscles. The walls of the stomach and other digestive organs have muscles in them that help to move the food about while it is digesting. Muscles move our eyes, and the vocal cords with which we talk. Some of the muscles are not under the control of our wills at all. They move and work right along whether we are awake or asleep. Look in your physiology to find the names of the muscles that are under our control and those that we do not control.

LESSON 15.—Let us think of some other work the muscles do besides moving the body. Straighten up with your head erect, your chest rounded out, and your shoulders back. What enables you to stand so straight and tall? Now let your head drop and your shoulders droop forward. Hold your hands across your back while you do this and then straighten up again. Do this several times. Do you feel the movement of the muscles along the spinal column? These muscles help to hold the spinal column straight. Other muscles help in holding our body in shape as well as in moving parts of it about. Another use of the muscles is to help protect some of the delicate organs.

LESSON 16.—What are muscles like? Do not spend much time in studying the structure of the muscles. Read what your physiology says about the structure and look at the pictures. The children should realize that all the lean meat of animals is made of muscles. The white tissue that holds the muscle bundles together in the meat is called connective tissue. This is easily found. The muscles in the leg of a chicken show the form of muscles very well. A small piece of lean meat cooked for a short time and then torn to pieces in a little water will show the bundles of muscle fiber.

FEBRUARY

OUTLINE FOR FEBRUARY.—*Muscles continued. Tendons; how related to muscles; illustrate by chicken leg. Bones; their relation to the muscles. Function of bones in protection of parts of body. Good positions in standing, sitting, walking. Necessity of forming good habits while young. Practice in erect carriage of*

body. Exercise; necessity; time; place; kinds; practice; effects of alcohol upon bones and muscles.

LESSON 1.—At the ends of the muscles are strong white cords called tendons that help to fasten the muscles to the bones. Look in the physiology for a description of the tendons. Straighten out your left arm. Now place the fingers of your right hand just over the elbow joint and bend your arm upward. Can you feel the cord like tendon that passes over the elbow as you move your arm? Can you tell where this tendon is fastened? Look at the back of your hand. Move your fingers up and down. Can you see the long tendons moving? Where are the muscles to which these tendons are attached and that help to move your fingers? (These muscles are situated at some distance up on the arm and yet they are able to move the fingers.) If you can procure the leg and foot of a chicken you will be able to show exactly how the muscles and tendons work together.

LESSONS 2, 3, AND 4.—The muscles cannot do their work alone. You found that the muscles on your upper arm thickened up, and the tendon which passed over the eblow joint pulled on the part of the arm below the elbow. The muscle could not have done its work if the tendon had not been fastened securely to the bone of the lower arm. What, then, is one of the uses of the bones of the body? (They serve as attachments for the muscles and so make it possible for the muscles to do their work.)

We think of the bones as making up the framework of the body. With the aid of the physiology have the children learn the chief group of bones in the body, skull bones, ribs, shoulder blades, collar bones, spinal column, arms, hips and legs. Spend some time identifying these groups of bones first by use of pictures and then in their own bodies. Spend some time in discussing the importance of the spinal column. Have the children see that it is the part that helps to support all the rest of the body. If this is bent or crooked the whole body will be bent or crooked. Have the children recall that it is the large muscles along the spinal column that help to hold the spinal column erect.

LESSON 5.—Some of the bones are used to protect the delicate vital organs of the body. Can you think of any that do this? Study this from the physiology. Have the children summarize all the uses of the bones.

LESSON 6.—What is the difference between children's bones and those of grown up people? Have you ever noticed the tip of the breast bone of a chicken? How does it differ from the rest of the breast bone? This soft white part is called cartilage. Many bones of little children are like cartilage and as the children grow older the soft bones become harder and harder. If this is true you can easily see how the bones of children may be bent and instead of growing straight grow crooked. If we really want our bones to grow so that we shall be straight and tall when we are men and women we must begin when we are children to hold ourselves erect. We all like to see a person who is straight. He looks very much better than one who is round shouldered or who stoops far over. How may we grow straight and tall? Here is a rule that was given by a teacher of physical training to help you to remember how to stand: Place your feet firmly on the floor your weight on the balls, and not on the heels. Now stand with your head pushed up as high as you can. Round out your chest and keep your belt in. Hold your chin in and think of your neck pushing against your collar. Practice standing erect, not once but many times until you form the habit.

LESSON 7.—There are some things that you should think about, not in order to do them but to avoid them if you are going to form correct habits of standing. Do not stand on one foot for any length of time or you are likely to grow one sided. Do not lean against the desk or other object, but stand up straight on both feet. Practice standing correctly in class. The teacher should feel that time spent in actual practice is worth much more to the children than time taken to discuss how they should stand. What advantage will it be to the children to *talk* about how to stand erect and not put this knowledge into practice?

LESSON 8.—To learn to sit correctly is just as important as to stand well. We should not sit near the edge of the chair but well back with the lower part of the spine resting against the back of the chair or seat. The seat should be low enough to permit the feet to rest upon the floor. The teacher should see to it that

each child has, if possible, a seat that is suited to his size. Practice sitting properly. This does not mean sitting stiffly without moving the position, but it does mean avoiding all the things that tend to make round shoulders and limp backs.

LESSON 9.—Can you think of some other wrong positions in sitting? Do you ever see any one sitting on the edge of the seat and yet leaning back against the back of the chair? It is not hard to see that he is likely to make himself round shouldered. Do you bend over while you are reading or writing? If your desk is the right height you can form the habit of sitting erect while you are writing and reading. Do you ever sit on one foot? If you do, try to break up the habit, for you are likely to twist your hip and sometimes your spinal column by doing this.

LESSONS 10 AND 11.—There is one other part of the body in connection with bones and muscles that we should know something about. How are the bones held together? Of course you have already seen that the muscles help in a way to hold the bones in good position but what makes it possible for the bones to work so freely upon each other? It is of course the joints. Use your physiology to find out all the different kinds of joints in the human body. Now look for illustrations of these kinds in your own body. What kind of a joint in your elbow? In the hip? In the fingers? Shoulder? Knee? etc. How are the bones at the joints held together? Look in your physiology to find the answer to this. Look for pictures showing the ligaments that hold the bones together. What happens when you sprain your wrist, or ankle, or knee? Some of the ligaments are torn loose. It takes a long time for these ligaments to grow firm again. In fact, it often takes longer for a bad sprain to entirely recover than for a broken bone to heal and become strong.

LESSON 12.—*Exercise.*—Discuss with the children why we should exercise. They should appreciate the fact that exercise is one of the things needed to keep us well and strong. It makes the blood flow faster and the food digest better. It makes us breathe more deeply, and even makes us think better. We should take regular exercise and the right kind if we are to get most good out of it. Have the children name some of the ways of exercising. Work and play are the two most common methods. Some people take all their exercise in work and others all in play. The best plan is to have some of both kinds. Name some of the games that are very active, such as running, jumping, skipping rope, etc. How do you feel after you have run very fast for a number of minutes? Name some games that do not require as much effort as running and jumping. All of our games are good for us if we do not play too long and if we play regularly every day.

LESSON 13.—*Place and time to exercise.* There is but one best place to play active games and that is out of doors. Can you think why this is so? The outdoor air is always pure. Do you breathe any faster, use any more oxygen when you exercise than when you are quiet? You see then how important it is to have plenty of air while you are exercising. If you play indoors see to it that the room is as full of fresh air as possible.

Is there any time that is better for exercise than another? You should not take very violent exercise just before eating. If you are very hot or tired from running or playing you should rest a short time before you eat anything. In the same way it is not a good plan to exercise immediately after eating. Just after eating the blood is needed in the stomach and if you exercise too much the blood will go to the muscles. A good time to exercise outdoors is during recesses, at noon and before and after school. When you have been sitting still reading, studying, or sewing for an hour or more you should take a few minutes for some kind of exercise.

A few moments given to vigorous exercise of the arms and to deep breathing with the window wide open every hour will do much not only to keep the children in a better condition physically but will also enable them to do better mental work.

Another thing to remember about exercise is that it will do most good if you exercise regularly every day, not a great deal one day and very little the next. Country boys and girls have the very best chance to exercise in the open air, long walks to school, outdoor work, riding and driving ought to help keep them strong and well, but at the same time they need to exercise to use the muscles that will help them carry their bodies erect and to sit properly just as much as the girls and boys of the city do.

LESSONS 14 AND 15.—Have the children name all the ways that we have already talked about that help us to keep the muscles and bones in good condition. In order to have strong muscles we need, of course, good food to eat, and good air to breathe. There are some things too that we should avoid, among which is the use of alcohol or tobacco. A man who uses a great deal of alcohol usually has weak, soft muscles which cannot endure the same amount of work that they could if alcohol were left alone. I wonder if you know that when athletes are training for football or some of the big track meets they do not use any alcohol or any tobacco. They know they will not be as likely to succeed if they use these stimulants. It seems pretty evident also that boys who use tobacco while they are young are likely to be stunted in their growth. That in itself is a good reason for leaving cigars and cigarettes alone.

Can you think of any reason why business men, as a rule, do not hire boys who have formed the habit of smoking cigarettes? Careful records have been kept which show that boys who use tobacco are not as reliable, all other things being equal, as the boys who are free from this habit. You probably know that the bad effects of tobacco and alcohol on boys is considered so important that laws have been passed in our own state and other states by which any person selling these stimulants to boys shall be punished by imprisonment or by a fine. Read all you can find in your physiology of the effects of tobacco and alcohol on the muscles and bones.

MARCH

OUTLINE FOR MARCH.—*Forms of water, liquid, solid, ice, snow, frost, hail, vapor, "hard" and "soft" water. Simple experiments. Uses of water as a liquid, as a gas, as ice. How is ice stored for summer use? Refrigerator.*

Hygiene of feet. Bones and parts of the foot. Care; desirability of free motion of the toes. A good shoe.

Leather, kinds, sources, methods of preparation, various uses, values; care of leather.

LESSON 1. FORMS OF WATER.—Today we are going to talk about something that you have known all your lives; something that you cannot live without. It is so common that you probably have never thought there is anything very wonderful about it and yet it is one of the most wonderful things in the world. This that we are going to talk about is water. We call water a liquid. Can you think of any other form in which water is sometimes found? Does it ever become a solid instead of a liquid? What happens on a cold night when you place a cup of water out of doors? When water freezes it changes from the liquid to the solid state. How cold does water have to become before it freezes? (Thirty-two degrees Fahrenheit). Look on your thermometer to find this point. Look at a piece of ice. Is it the same throughout? Did you ever watch a pond or a puddle of water begin to freeze? Where does it freeze first? How does it freeze?

LESSON 2.—We have already found that water may be in the form of a liquid and also in the form of a solid. Does water exist in any other form? To answer this question we shall try a simple experiment. Put a little water into a tin cup and set the cup upon the stove or in some warm place. Leave it there a short time or until the next day. What has become of the water? We say it has evaporated. That means that the water has changed into a vapor or gas. What do you think became of the vapor? It went off into the air. Can you see this water vapor in the air? (We cannot see water vapor any more than the other gases of which the air is composed. They are all invisible.) If we should set a pan of water out of doors on a warm day will it change into vapor? What becomes of the water in puddles? in the road? in clothes when they are hung out upon the line? We say the clothes dry, but what really happens is that the water evaporates; that is, it changes to vapor and goes off into the air. Name other examples of evaporation of water.

LESSON 3. RAIN.—What do you think becomes of all the water vapor that goes into the air from the rivers, oceans, lakes and streams? Does it always remain invisible? Watch the spout of a teakettle when the water is boiling very hard. Can you see anything for a short distance from the spout? There is something

there although you cannot see it. I am sure you can think what it is,—invisible water vapor coming from the water in the teakettle. What do you see a little further out from the teakettle? We call this steam. It is the vapor slowly changing back into water again. Whenever invisible water vapor is cooled it changes back into tiny drops of water. We say it condenses. Try to catch some of the vapor from the boiling teakettle. To do this set a cup out of doors or in some cool place until the cup is thoroly cool. Now hold it close to the spout of the teakettle and let the vapor pour into it. What takes place? How much water can you obtain in this way? You now see that heat changes water into vapor and when the vapor is cool it changes back into water again. Steam is made up of such tiny drops of water that they are light enough to float in the air.

Does any of the vapor that goes up into the air from the earth's surface ever change back into water so that you may see it again? This is what happens. As the vapor goes up into the air it is cooled just as it is when the steam gets some distance from the teakettle. What does it form? (The children will readily see that this forms clouds. In fact the steam you see near the teakettle is a small cloud. When the clouds are cooled still more, the tiny drops of mist unite with one another and soon get so large that they can no longer float in the air.) Then what happens? They come down in drops and we have a shower of rain.

LESSON 4.—Have the children review the story of the raindrops. Have them think of the rain first as water on the earth or in the river, or ocean. It changes to vapor and floats upward. Is it visible or invisible at this time? Third, it is cooled and forms clouds. Fourth, when the clouds become cooler, what happens?

The water from the clouds does not always fall in the form of rain. Name other things that come from the clouds (snow, hail, sleet). Did you ever pick up a hail stone? What shape was it? Do hail stones look like ice? How do you suppose they are formed in the clouds? Sometimes, just as raindrops are forming in a cloud, the cloud moves into some air that is freezing cold, or perhaps the freezing cold air moves into the cloud. What happens to the drops? They freeze solid and fall in the form of hail. When do we have hail storms most frequently? This means then that high up in the air it is freezing cold when we are having hot summer weather down upon earth.

LESSON 5. SNOW.—Can you think how snow is formed? When a cloud of mist that is not yet formed into rain drops becomes very cold it freezes, forming snow crystals. The crystals often unite forming the large snow flakes. Did you ever catch snow upon your coat sleeve and notice the form of the flakes or crystals? Snow crystals are all six-pointed stars, or at least they have six rays. The outer part of the crystal may not always show six points. Sometimes when there is fine dry snow you can easily see the six-pointed stars if you catch some of the crystals upon a dark piece of cloth. Has much snow fallen this winter? Has it stayed upon the ground a long time? Have you ever noticed the direction from which most of our snow storms come? Is the snow of any value to us in the winter time? What are some of the plants that are covered by the snow? (wheat, clover, alfalfa, strawberry, wild flowers, etc.) Is the snow covering of any use to these plants? (The snow protects these plants from severe freezing weather. While the snow is cold it really acts something like a blanket for these plants.)

LESSON 6. FROST.—Watch for white frost on the ground and plants and walks. Name all the places that you have seen frost this winter. Do we ever have trees covered with white hoar frost? What is the color of hoar frost? See how many different forms of frost you can find on objects out of doors. Do we ever have frost inside of our homes as well as out of doors? How many different figures can you find in the frost work on the window panes?

Where does the frost come from? We must think again of the invisible water vapor in the air. You have not forgotten what happens when it is cooled. Now suppose the walk or ground becomes very cold at night and the air with the water vapor in it touches the cool objects. The vapor will at once start to change back into water and before it is fairly changed it freezes and we have beautiful frost crystals. You see then that the frost on the window panes in our homes is nothing but the vapor that is in the room touching the cold windows and freezing.

LESSON 7. DEW.—In the summer we have dew instead of frost on objects out of doors. Are you ready to tell now where the dew comes from? It, too, is

water vapor from the air or sometimes moisture from plants. Did you ever have the dew settle on the outside of a glass or pitcher filled with cold water on a hot day in summer? Can you explain where this dew came from? Was the pitcher cold or hot on the outside when filled with cold water? When the vapor in the warm air of the room touched the cold pitcher what happened? It was condensed and formed into drops of dew. In the same way dew forms upon objects out of doors in the summer time.

LESSON 8.—What do we call water that we catch from rains in the cistern, or pails, or tubs? Why is it "soft water"? To help answer this question let us think of well water. Do we call it soft or hard? What do we mean by hard water? To answer this put some soap into a pan with a little warm well water in it and stir it around for a few moments. What happens? At first you notice that it becomes milky and then a little scum arises on the top. This is a sure test of hard water. Now put some soap in the same way into soft water. How does it differ from the hard water? Must not hard water have something in it that the soft water lacks? Where did the water in the well come from? Was it ever rain water? All well water was once rain that soaked into the ground and moved slowly downward, but it has changed as it moved through the ground. A simple experiment will show something of what happened. Put a few spoonfuls of salt into half a cup of warm water. Drop it in a little at a time and stir until it all disappears. What has become of the salt? It has dissolved in the water. We say that a solution is formed. In the same way water in the ground dissolves different substances through which it passes. Some of these substances are lime, sometimes iron, and magnesium. We cannot see them in the water any more than we can see the salt in the cup of water. That is, they are in solution in the water. These make the water hard.

LESSON 9.—Place upon the stove the cup of water into which you stirred the salt and let it remain there till all the water has disappeared. Now look into the cup. Did the water vapor as it passed out take the salt with it or is the salt left behind? If you had caught the vapor and let it turn back into water would it have been soft or hard? It would have been soft, for it had left behind in the cup all the salt. In the same way when water goes up into the air as vapor it leaves behind in the river, lakes, etc., all of the substances that make it hard.

Look into your teakettle to see if you can find a coating of lime and other substances that the water has left behind when it boils and changes into vapor.

LESSON 10.—Have the children name all of the uses of water that they know, especially of soft water. Is ice of any use to us? (Skating, use in our refrigerators, making ice cream, etc.) How is ice stored for summer use? If some one in the district has an ice house, let the children describe this. An ice house is made usually with two walls, often with sawdust between to keep the ice cool. It, too, is often surrounded by sawdust. In this way all the warm summer air is kept out and the ice remains solid during the warmest weather.

LESSON 11. PHYSIOLOGY.—Hygiene of the feet. Discuss briefly with the children the uses of our feet. The chief one is to bear easily the weight of our bodies while we are standing and walking. Study from the physiology the parts of the foot, the number of bones, how they are fastened together with the ligaments, and the arches of the foot. Impress the children with the fact that one of the important things to consider in the care of the feet is to keep the toes free to move so that they as well as the ankle may be of value to us in walking and running.

LESSON 12.—What are some of the other things that we may do in caring for the feet? One thing we should do is to see that we wear shoes that fit the feet perfectly. That means that they will not be too large nor too small. The sole should be the same width as the foot. What kind of heels should the shoes have? They should be broad and rather low. The inner side of the shoe should be straight so that the great toe should be in the same straight line with the side of the heel. The shoe should also allow all of the toes to point straight forward. Do you think that a very pointed shoe would do that? What is a pointed shoe likely to do to the toes? It not only prevents freedom of the toes but in time deforms the foot because it presses the great toe too far over at the top, and sometimes causes the joint to become enlarged producing corns and bunions. Patent leather shoes are

not a good kind to wear. In summer they are likely to keep the feet too warm. In cold weather they are likely to keep the feet too cold. Tan or russet shoes are much cooler in summer than black ones. Another thing to remember in caring for the feet is to keep them dry and just warm enough to be comfortable. If they are too warm they are likely to perspire freely which may be injurious to the feet if the stockings cannot be changed frequently.

Another thing to be observed is the lacing of the shoes. Did you ever lace your shoes so tightly that little ridges were formed between the laces? Can you think why we should not do this? It keeps the blood from circulating freely and so prevents free action of the foot, especially of the ankle. Tight garters are just as injurious.

We should try to form right habits of using the feet in standing and walking. If it is important to use the toes, then we should practice so that the muscles may keep strong and able to do their work. Some exercise will help in this. Raise the heels from the floor, bearing the weight upon the toes. Practice this a number of times each day. Try to walk with the toes straight forward not turned out nor turned in. It is very important that the children learn while young to value the importance of comfortable shoes, so that their feet may move with ease and freedom, and they may avoid the deformed and painful feet that so many of their parents possess.

LESSON 13. LEATHER.—What are your shoes made of? Are all of your shoes made of the same kind of leather? Look at them and see how many different parts you can find. If you should rip them to pieces, how many pieces would you have? The lower part of the shoe that covers the toes and extends around to the heel is the vamp. The back stiff part of the heel is the counter. The tip covers the front part of the vamp over the toes. The upper part that is sewed all around to the vamp is the top or quarter. The vamp and the quarters when sewed together form what we call the upper. Then there is the sole and the heel. Can you tell how the sole is fastened to the upper in your shoe? Some shoes have the soles sewed on, some have the outer sole tacked on. How is the heel made? Can you tell whether it is in one piece or many pieces? There is another part of the shoe that you cannot see, a little steel strap in the instep that helps to support the shoe and keep it in shape. This is called the shank.

LESSONS 14 AND 15.—What is leather made of? Can you name all of the animals whose skins are used for this purpose? (Cows, calves, horses, sheep, goats, dogs, alligators.) The skins of the large, full-grown animals are called hides; those of small animals, such as calves, sheep, goats, and dogs, are called skins. Which do you suppose yields the softer leather? Leather made from hides is very thick and heavy. It is used for the soles of our shoes and for other things where heavy leather is necessary. Do you know how leather is made? Have you ever heard of a tannery? That is the place where hides and skins are taken to be made into leather. It would be very interesting to visit a tannery to see just how leather is prepared for our shoes.

In the first place we should know that the structure of the skins of animals is very much like that of our own skin. On the outside is a layer called by the same name that ours is,—the epidermis. Under this is the true skin or dermis. Attached to the outside layer is the covering of hair.

The first thing that is done when the hides and skins are brought to the tannery is to wash them in clean water to remove all dirt. If they are dry, as they often are when shipped from long distances, they are soaked in luke-warm water until they are softened. Then they are placed in large vats with a solution of lime. Heavy hides are left in the lime only a few days, but the skins that are to make soft leather for our shoes are left in the vats from fifteen to twenty days.

The next process is to remove the hairs and epidermis. To do this the skins are taken from the vats, laid upon a rack, and scraped. Next they are put into another solution for the purpose of softening the fibers. The skins are now ready to be tanned, which really makes them into brown or reddish colored leather. The tanning fluid for this purpose is made of various things. Most of the tanning fluid or tannin is made from the bark of oak trees and hemlocks. After tanning the leather is oiled. Sometimes in connection with the oiling coloring matter is put in. That is usually the case in the making of black leather. The leather is

rubbed with a mixture of lamp black and oil. Colored leathers are dyed with certain kinds of dye stuff after they are tanned.

LESSON 16.—Name all the articles that you know that are made of leather besides shoes. (Belts, suit cases, pocket books, gloves, mittens, harness, buggy tops, trunks, etc.) It would be interesting to visit a cobbler or shoemaker and get small samples of different kinds of leather. Are leather goods expensive? The finer the leather the more expensive it is. Do you know how the fine leather of which our gloves are made is obtained? This is made in exactly the same way as the leather for our shoes, but from the finest of the goat skins.

How should leather goods of any kind be cared for? The most important thing is to keep the leather from becoming hard and dry. This may be done in various ways. Oiling or blacking the shoe helps to keep the oil that is in it from escaping. Wading in water or wet snow is very hard on shoe leather. Can you see why?

APRIL AND MAY

OUTLINE FOR APRIL AND MAY.—*Trees. The elm tree (maple or oak as alternative); study of twig at time of bud opening; distinguish flower bud and twig bud, follow development; kinds of elm (maple or oak); uses of wood; historic elms and oaks; calendar of typical tree. Oak and elm galls.*

Garden. Plan the home garden and discuss what seeds to plant. Study seed catalogues. Grow radish and lettuce for early market or home consumption. Choose several different kinds to determine the most desirable.

Underground parts of plants used for propagation; bulbs, tubers, roots, etc. Study onion as a type. Sets, seeds, bulbs, top onions. Set out dahlias and plant seeds of other plants. If practicable make a small flower bed on the school grounds.

Make plans for vacation observation and study. Plant beets, parsnip, and other biennials for fall study. Set out some roots of beets and turnips to produce seeds.

NOTE.—The topics of the lessons arranged below are prepared for the soft maple, but may easily be modified to fit the elm or any other tree that may be selected. There are a few points of difference, however, that may be stated. The elm blossoms about as early as the maple, but the flowers are all of the same kind. Each flower has its own stamens and pistil, while the maple has two kinds of flowers, one bearing stamens and the other pistils.

The uses of the elm differ somewhat from those of the soft maple. Because of its graceful form and its endurance it is a favorite shade tree everywhere. The wood is very tough. It is used in making parts of the wheels of vehicles, flooring, many agricultural implements, and is used extensively in ship building. It is also used largely in the making of barrels and kegs.

There are several historic elms that are worth mentioning. The Washington Elm in Cambridge, Mass., gets its name from the fact that Washington is said to have first drawn his sword under this tree when he took command of the army of the Revolution. Penn's elm was a great old tree that was probably 200 years of age when Penn came to the new world. Under this tree Penn and the Indians met and made the famous Penn treaty. This tree blew down in the year 1810.

LESSON 1. TREE STUDY.—Tell the children that tomorrow we are going to talk about the soft maple tree. How many have some of these trees in their yards at home? Look closely at one and be ready to tell whether the trunk is smooth or rough, whether it has many large branches, and whether the trunk and branches are the same color? Do the branches spread out or grow upward? Are there many twigs? Are they crooked or straight? Do they droop or stand erect? What is the shape of the tree? Stand off at some distance and look at it. Is it round? Is it wide at the bottom and pointed at the top like a pyramid? Is it the form of a wide column or is it shaped like an umbrella? Are there any leaves on the tree? Any flowers?

LESSON 2.—Bring a few twigs of the maple into the school room. Place them in water to keep fresh. How many different things can you find on one twig? (The children will find the buds, scars where the leaves were attached last year, and ring scars which tell each year's growth.) How many years old is the twig? Where are the buds? How are they arranged on the twig? Are they opposite or alternate?

Is there one at the end? What will a side bud become? an end bud? To answer these questions watch the development of the buds outside, or place twigs in water in the schoolroom. Draw a twig showing all the things you see.

LESSON 3.—On some of the trees you will find at this season the flowers, or the small clusters of young fruit. If you find the flowers, examine them carefully and note how beautiful they are. You will find that all the flowers are not alike, some have the stamens which bear the yellow powder called pollen, and others have pistils which grow into the fruit and seeds. The flowers that bear stamens are called staminate flowers, and those that bear pistils are called pistillate flowers.

LESSON 4.—After the flowers have disappeared watch the rapid development of the fruit. Make sketches at different times showing the growth of seeds and the wings. Do you find that the paired seeds are always about the same size? When do the seeds begin to fall? Watch them flying down from the trees, whirling around, fluttering like butterflies. In what way are the wings a help to seeds? How far away from the tree do the winged seeds travel? Why is it an advantage for them to get away from under the parent tree?

LESSON 5.—Gather a number of the seeds and plant them in the school garden or in flower pots or boxes in your window garden. Suggest to the children that they also plant some at home. How long after the planting before the young plants begin to appear? How many leaves has the little tree at first? Do these look at all like maple leaves? Watch for the appearance of the next leaves. Where do they appear? What becomes of the two long slender leaves which appeared first? Can you find any young maple trees that have planted themselves? Where are they?

LESSON 6.—Some time should be given to discussion of the value of the maple. Find what uses the children can name, such as shade, nesting and feeding places for birds, fuel and furniture and sugar marking. Are there any objections to the soft maple as a shade and ornamental tree about the house?

LESSON 7.—Do you know any other kind of maples? The sugar maple is found in many of the woods of Illinois. The Norway maple is used in many places as an ornamental tree. It has the roundest head of all the maples. The box elder, which is found in many parts of Illinois, is a close relative of the maples.

LESSON 8.—By observation the children will see that a bud develops into a twig with leaves on it. Leave with them the question as to whether leaves continue to open up at the end of the twig. Toward the end of the term examine the twigs again with this in mind. Note the length of the new twigs at this time. Encourage the children to watch some particular tree during the summer to see how long new leaves continue to appear, or what other changes may be noted.

Another interesting exercise is the keeping of a calendar of an individual tree accompanied by sketches. The calendar should show the date of flowering and of opening of leaf buds, when the leaves are fully grown, when the fruit ripens, when the young trees begin to grow from the seeds, and any other points of interest. Simple drawings showing stages in the development will add much value to the work.

THE GARDEN.—The teacher should make every effort to have the children start home gardens of their own. Make plans for planting vegetables, especially those that have been studied, so that there may be a display of them at the exhibit next September. Plant beets, parsnips, carrots, and salsify; onions as suggested in the lesson on bulbs. Ask each child to set out at least two beet roots that have been kept over winter; also two turnips for the purpose of raising seeds.

Help the children to plan a simple flower bed for their home garden. A plot four to six feet wide and ten feet long is large enough. Plant two or three different flowers in this. A nice arrangement for the fourth grade is as follows:

Set out a row of dahlias along the outside of the bed. In front of this and about fifteen inches away, plant a row of zinnias or sweet scabious and in front of this, as a border, sweet alyssum. An entire bed of petunias may be planted, or one of nasturtiums. All of these flowers, if well taken care of, will blossom in the fall in time for the flower exhibit.

RADISH AND LETTUCE.—In preparation for the study of the radish and lettuce send to seed houses for catalogs (any of the following will send catalogs free: Vicks' Sons, Rochester, N. Y.; Peter Henderson & Co, New York City; Henry Field & Co., Shenandoah, Ia.; Henry A. Dreer, Philadelphia, Pa.)

LESSON 9.—Study the different varieties as described in the catalogs. Which are best for early results? Which for a late crop? If possible send for two or three varieties to test them. Each child should plant a small plot at home. If there is a school garden, let the class plant a few of each kind. Discuss method of planting. How deep should the seeds be planted? A good rule to follow for most seed is this: the depth should be almost four times the diameter of the seed. How far apart should they be planted? They should be at least one inch and a half. Two inches are better for the summer varieties. Why should they not be crowded?

LESSON 10.—Record the date of planting, when the first leaves appear, when the second leaves appear, and when the first radishes are large enough for table use. Do different varieties differ in this respect? Test the quality and flavor of the radishes and decide which kind you like best. Does the rapidity of growth have any effect upon the crispness of the radishes?

The same general plan may be used for the study of the lettuce.

LESSON 11. BULBS AND OTHER UNDERGROUND STEMS.—Ask the children if they can think of any plant that we start in our gardens in some other way than by seeds. They will probably name potatoes, onions, sweet potatoes, dahlias, etc.

The onion is a good type for detailed study. The materials needed for these lessons are a few large onions, several onion sets, if possible a stem with top sets or bulblets, and some seed. Begin by asking the children what an onion is. To answer the question have them examine the large onion. What do they find at the lower end? (The fine fibrous roots will be seen.) Look at the other end for the shoot or bud. Is it beginning to grow? What then does the onion resemble? Since it has roots at one end and a growing shoot that is opening into leaves at the other it should be possible to answer. (It resembles a stem, and since it grows in the ground we call it an underground stem.) This particular kind of underground stem is called a bulb. What is on the outside of the bulb? What do you think is the use of the dry, paper covering? To answer this have the children remove the skin and then place the onion on the window sill where it will get the rays of the sun and also the air. After four or five days examine to see what has happened. (From this the children will see that the dry paper covering keeps the onion from drying out.)

LESSON 12.—Let us look more closely at the onion bulb to see how it is made. Cut it in two across the middle and notice that it is made up of layers. Where are the layers thicker, at the outside or toward the center? What is the color of the central portion? What is the relation between this and the shoot? (This is really the beginning of the shoot.) What uses are the thick juicy layers to the growing onion? Try the following experiment. Procure a wide mouthed bottle, a pickle bottle will serve the purpose, fill it with water, and put an onion in the mouth so that the lower part will be in the water. Place the bottle on the window sill and watch the growth of the onion from day to day. Where does it obtain the food with which to grow? (The children will readily see that the bulb furnishes the food for the growing leaves and roots.) What will a large onion do if we plant it?

LESSON 13.—How do we get new onions to eat during the summer? Let the children tell what is used at their homes. Some probably plant sets, some seeds, and and some top onions. Let the children examine some sets. How do they differ from the large onion? Do they have the dry covering, the layers, the tiny roots, and the shoot? They are just like the large onions except in size. In fact, they are nothing but little bulbs. Last year's onion seeds were planted late in the season, the last of June or the first of July. In the fall the tiny bulbs were taken up, dried, and kept all winter. If we set some of them out in the ground this spring they will grow rapidly and in about six weeks we may expect to have onions large enough to eat. The sets may be planted very early, for onions are hardy and can stand the cool spring nights without injury. How should they be planted? (Plant them in

rows two or three inches apart, cover with soil and firm the soil well around them. The rows should be twelve or fifteen inches apart.)

LESSON 14.—Discuss how the seed beds should be prepared for onions, whether we plant sets or seeds. Onions require rich soil, the richer the better. It is a good thing to plow the ground in the fall, plowing under a good dressing of manure. Before planting, the soil should be made very fine, especially the two or three inches on the top.

Let the children examine the seeds. What is the color? How many have ever seen an onion in bloom? How shall we plant the seed? Sow in rows. The rows should be from twelve to sixteen inches apart. When the plants are an inch or two high they should be thinned until they are about two inches apart.

Should onions be cultivated? How many of the children help weed and cultivate onions at home? It is a good thing to hoe the soil towards the little sets so the stems will become white. With the little onions grown from the seeds, however, the soil should not be thrown up around the stem. We want to give this bulb a chance to grow and spread out near the surface of the ground. Why? (We want it to make a large onion to use during the winter.)

An experiment may be tried in the school room, in the school garden, or at home to see whether onion seeds germinate quickly and whether the young plants grow slowly or rapidly. Plant a few seeds in a box of soil, keep warm and well watered, watch for the appearance of plants. In the same way compare the growth of onions from sets and seeds.

LESSON 15.—It may be worth while spending a short time in the discussion of other ways of propagating onions. Perhaps some child knows of the multipliers or potato onions. Onions multiply in the ground. If one bulb is planted soon a number of new bulbs grow from it. These new bulbs are never very large, but many people consider them very good to eat.

Other kinds of onions produce little bulbs or "bulblets" at the top of the stem. These little bulblets are often called top onions. Some people call them "sets," but they are not the true onion sets which have already been described. These top onions may be planted in the spring just as the true sets are, and they will produce onions for early use.

There is still another kind of onion known as the winter or evergreen onion. This lives out of doors all winter. The bulbs of the winter onion grow in clusters. In the early spring, sometimes before the snow is gone, these send up their fresh tender stems. If one of the clusters is dug up and broken apart and the bulbs set out separately each will produce a new cluster.

LESSON 16. WILD FLOWERS.—Follow the lessons on the onion with a brief study of the wild flowers of spring. What are some of the earliest flowers that we find in the woods? The children may know the hepatica, violet, spring beauty, dog-tooth violet, Jack-in-the-pulpit, and others. Try to have them solve the problem, how can the wild flowers send up their flowers so early in the spring? If wild flowers are numerous in the vicinity of the school dig up one or two to show the children the underground stems. They will find if they dig deep enough that spring beauties have tubers like potatoes, the dog-tooth violets have bulbs like onions, and the violets have thick root stocks. What is stored in all these underground stems? (Just as the onion bulbs have food stored in them that the onion uses as it grows, so the wild flowers the summer before stored up plenty of food material for the plant to live upon in the early spring.) What other preparation did the onion make last fall? You remember the little shoot that is all ready to grow the moment it gets a chance? In the same way the wild flowers have their flower buds all ready the summer before so they are ready to open up at the first indication of spring.

VACATION STUDIES.—Discuss with the children how they can care for their gardens. All weeds should be kept out. The soil should be stirred frequently even if there are no weeds to pull out. When the flowers begin to blossom they should be picked occasionally. They will blossom all the better for this. In gathering flowers it is better to use a large pair of shears and cut the stems instead of breaking them. The stem should be kept as long as possible. Keep a record of how many radishes and how much lettuce you raise and be ready to tell which kind you think is best.

LESSON PLANS FOR FIFTH YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER.—*(Alternating with sixth year's work; ten minutes daily, or, preferably, three longer periods each week.)*

Report on vacation studies. Fall aspect of garden. Harvesting and storing of onions and other underground plant parts.

Grasshoppers; collect different kinds,—locusts, meadow grasshoppers, katydid; field study to discover habits and food. With specimens in cages, observe how much one grasshopper will eat in one day, method of breathing, of making sounds. How may grasshoppers be destroyed? Allies,—crickets, cockroaches, walking sticks.

(Nineteen lessons planned.)

REPORTS OF VACATION STUDIES. LESSONS 1 AND 2.—The first lesson should be an informal discussion of the vacation work and studies. If the children have observed grasses and dandelions let each tell in his own way what he has seen. When did the bluegrass blossom? How tall does the flowering stem grow? Did anyone find seeds on the bluegrass? How can you tell bluegrass from timothy? (If possible the teacher should have in class a few dried heads of these kinds of grasses.) How many observed the dandelion during the summer? Did it continue to blossom during the summer months? Did the leaves grow any taller in the tall grass than in the short grass of the lawn? Look for dandelion flowers now. Who discovered whether or not dandelion seeds grow the first season?

LESSONS 3 and 4.—Have the children report on garden studies. How many have onions in the home garden? Ask the children to observe the following and report the next day. Have any of the onions gone to seed? Have any of the stems little bulblets on the top? How large are the onions that were started from seeds in the spring? How large are those that were started from sets? (The teacher should have in class for the next lesson specimens of onions grown in various ways.) A comparative study should be made of these. Discuss the harvesting and storing of onions. Encourage the children to tell how the work is done at their homes. The following rules should be observed in harvesting the crop. The bulbs should be pulled or dug up and left for several days to dry. The tops and roots should then be cut off and the onions placed on the floor of a barn or crib or in some dry place. They should be scattered thinly on the floor and not piled up. When thoroughly dry they may be placed in the cellar or basement for winter use. The methods of storing other garden plants for winter may be discussed. Are any roots left in the ground over winter? (Parsnips and salsify.) Discuss the care of dahlia roots. (After the first biting frost they should be dug up, dried and stored.)

GRASSHOPPERS AND THEIR RELATIVES.—A few simple pieces of apparatus will aid in the study of grasshoppers. Two or three quart Mason jars, several wide mouthed bottles, a few jelly glasses with covers, a flower pot or tin pail to hold soil, two or three lamp chimneys or lantern globes and a wire cage or vivarium. A vivarium is easily made. For the foundation make a shallow box a foot and one-half or two feet long, six inches wide and three inches deep. Nail firmly in each corner a flat piece fifteen inches high, about an inch wide, and half an inch thick. Complete the frame by nailing pieces of board to the top of the uprights, covering the sides with wire screen or mosquito netting and placing a piece of board or panes of glass over the top. A simple cage may be made from an ordinary shoe box. Cut rectangular pieces out of the top and bottom of the box and sew in wire screening or mosquito netting. Tie a string around the box to keep the lid on. Stand it up on one side and you may watch the movements of the grasshoppers within.

LESSON 5.—Discuss briefly with the children where grasshoppers are found. Give them the following points for individual observation outside of school hours. The study may easily be done on the way to and from school. Watch to see just how the grasshopper moves out of your way. (It will not be difficult for the children to see that the movement is a combination of flight and hop.) How do they alight? Where do they alight? Do they make any effort to conceal themselves? Does their color help them any in hiding from you? Bring a few live grasshoppers to school tomorrow.

LESSON 6.—Call for reports upon the observation made in the field. Place some of the live grasshoppers in the vivarium. Let each child have one in a bottle or glass. Watch to see how the hoppers move about in the cage or glass. How many legs have they? Are all the legs the same size? Can you find anything on the feet to keep the hoppers from slipping when they alight? How many wings can you see? Where are the wings that you saw when the insect was flying? Hold a grasshopper in the left hand and with the right thumb and finger gently lift one of the outer wings and notice how the inner wings are folded like fans. What do you think is the use of the outer wings? (These are used for protection of the more delicate wings underneath and are of no use for flight.) Are the outer wings any stronger or firmer than the inner ones?

LESSON 7.—The problem that the children are to solve today is what and how grasshoppers eat. Let the children tell what they think the grasshoppers feed upon. Place leaves of various kinds in the jars with the insects. Place sprays of clover, grass and other leaves in a small bottle of water and set this in the vivarium. Let the children find out for themselves how the grasshoppers nibble and chew the leaves. Hold a grasshopper in the hand and place a leaf near its mouth. It will soon begin to nibble the leaf. Have the children watch carefully to see how many parts of the mouth they can discover while the grasshopper is feeding. (They will be able to make out the flap-like upper lip, the dark toothed jaws that move from side to side and the four foot-like projections at the lower part of the mouth. These projections are called palps and the lower pair is fastened to the lower lip.)

Let the children try an experiment to see how much one grasshopper wil eat in a single day. Place one of the insects in a jar or glass and with it half a dozen blades of grass. How many blades are left next morning? Try it on other plants, clover, corn, etc. Sprinkle some water on the leaves and see if the grasshoppers like to drink.

LESSON 8.—How does the grasshopper find out things? Can it see you when you come near? Look on its head for eyes. Where are they? How many can you find? If you look closely you will find three small eyes besides the two large ones. One of these is in the middle of the face and one just in front of each large eye on the top of the head. Where are the feelers or antennae? What do you think the antennae are for? Can the grasshopper move them around? Does it touch objects with them? (The antennae are organs of touch. They also contain the sense of smell.) Does the grasshopper act as if it can hear? Raise the wings and you will see the ear spots on the back, one on each side.

LESSON 9.—Have the children look for other kinds of grasshoppers; among others they will probably find meadow grasshoppers. These are slender, greenish insects that live on the stems of weeds, garden plants, and corn. They have very long hair-like antennae, and often they sing all day long, stopping only a moment when you approach too near. Place two or three of these in the vivarium. Let the children observe them a few minutes to find in what ways they differ from the common short horn grasshopper. In the same way let them find in what ways they resemble the common grasshopper. How do these insects make their music? (Leave this as a problem for the children to solve by observation.) They will readily see the almost transparent musical instrument at the base of the outerwings. They will be able to see the insect vibrate this as it makes its music.

LESSON 10.—Do grasshoppers live all winter? (No, they all die in the fall.) Where do all the grasshoppers come from the next season? (Grasshoppers deposit their eggs the fall before and these eggs hatch a new generation of grasshoppers.) How and where do they lay their eggs? To determine this have the children fill some of the Mason jars about half full of garden soil. Firm this down and place one or two female grasshoppers in each jar and feed them well. You can tell the female grasshopper by the four projections at the back part of the abdomen. These projections form what is called the ovipositor or egg placer. Set the jars aside for a week or more.

LESSON 11.—We are now ready to find out something about another relative of the grasshopper, the cricket. Where do crickets live? Do you find them moving around in the daytime as much as grasshoppers do? Did you ever lift up a board and find a cricket under it? Bring some crickets into the schoolroom and study them

as you did the meadow grasshopper. What do crickets eat? Put some in a glass and feed them on various kinds of food. Watch to find how they make their music.

LESSON 12.—If you wish to see some cricket eggs, you may easily induce the cricket to deposit some for you. Fill some flower pots or tin pails almost full of soil. Then set a lamp chimney or lantern globe on top of the soil, pressing it down slightly. Put the cricket inside, and tie a piece of thin cloth or netting over the top of the chimney. Be sure to feed the cricket well. After a number of days, lift up the lantern globe or chimney and you will find in the crevice made by the chimney the interesting golden eggs of the cricket.

LESSON 13.—Perhaps the most interesting of all the relatives of the grasshopper are the katydids. You may have a hard time to catch one of these, but if you keep eyes and ears open, you will be sure to find one before the month is over. Put it into the vivarium and see how many interesting things you can find out about it. Look carefully at the base of the wings to find the triangular musical instrument. Carefully lift up the outer wings to see the beautiful ones beneath.

LESSON 14.—One relative of the grasshopper is a very bad pest about cupboards and pantries. This is the cockroach. Who has seen one of these? What color is it? Does it have the long hopper legs that the rest of the family have? (This insect has legs adapted for running instead of hopping.) What does it eat? If any of the children know this pest, they will be ready to tell how it devours any food that it may find about the home.

LESSON 15.—Examine the jars that were set aside for obtaining the grasshopper eggs. The children may have been fortunate enough to catch the insects in the act of digging holes in the soil and placing their eggs in these holes. Carefully remove the soil from the jars, pouring it out upon a plate, or some other flat object. You will find the packages of eggs an inch or two below the surface. The egg packages are from three-fourths of an inch to an inch in length and about one-third of an inch in diameter. Carefully open one package and study a single egg. What is the color of the egg, its shape? Break apart one of the packages and count the number of eggs. Some grasshoppers lay two or three packages. Where do the grasshoppers that are out doors place their eggs? (They are placed in the ground of the meadows, pastures and roadsides.) When do these eggs hatch? (Some of them hatch quite early in the spring if the weather is warm. They may be found in the latter part of March, others do not hatch until April or May.)

LESSON 16.—How do the young grasshoppers differ from the grown-up ones? (While most of the young grasshoppers are found in the spring and early summer, there are always a few belated ones that may be found in September.) Have the children search for these in the grasses of the meadows or roadsides. Place them in the bottles for study and feed them upon the leaves of grass and clover. Observe them for a few minutes to discover in what ways they resemble the grown-up insects; then study them a few minutes longer to find out how they differ from the mature insects. Find the beginnings of wings on the backs. (If young grasshoppers are kept for a time, the children may have the pleasure of seeing them change into the grown-up form.) This is done by molting. The little grasshoppers creep out of their old skins, then the wings unfold and grow and the hoppers are grown up.

LESSON 17.—Since grasshoppers lay so many eggs in the fall why is it that we do not have all of our meadows, pastures, and corn eaten up by them? (It is because they have so many natural foes.) Have the children try to think of some of the ways in which the grasshoppers are destroyed. Fall plowing often brings the eggs to the surface, where they are eaten by birds or other foes. Spring plowing destroys hundreds of eggs. Many grasshoppers are attacked by a fungous disease that kills them by hundreds in the fall. Ask the children if they have ever seen dead grasshoppers hanging to the tops of weeds and other plants? Whenever they find one of these grasshoppers they may know that it died of this disease.

This is a good time to talk about the birds that feed to a great extent upon grasshoppers. Just how much the birds do to keep the grasshoppers in check is difficult to estimate. The greatest benefactors among the birds are the meadow larks, quail, brown thrasher, bobolink, dick cissel, and the song and field sparrows.

LESSONS 18 and 19.—Make plans and arrange a program for the Harvest home festival to be held the last Friday in the month.

OCTOBER

OUTLINE FOR OCTOBER.—*Study of strawberry beds at home; report on old plants, runners, new plants, care of beds in winter.*

Continuation study of trees, especially of their autumn coloration and preparation for winter rest.

The mosquito; collection of eggs and larvae or pupae from stagnant water, rain barrels, or pools; follow life history; experiment in killing young with kerosene. Mosquito and malaria.

(Twenty-one lessons planned.)

MOSQUITOS. LESSON 1.—Begin the work with an informal discussion of mosquitos and their habits. The mosquito is so well known that the children will be able to draw upon their experiences for answers to some of the questions. How do mosquitos move about? How many wings have they? (If the children are in doubt about this leave it as a problem to be solved later.) Do mosquitos make any sound as they fly? (The humming music is made by the rapid movement of their wings.) When are mosquitos most active, during the daylight or darkness? Who knows where they stay during the daytime? (They hang on the ceilings of rooms, in sheds, barns and other buildings, and on twigs and the undersides of the leaves of trees and other plants.) What do they eat? (The children will, of course, say that they feed upon the blood of human beings and other warm blooded animals. This is true, only in part. Mosquitos live very largely upon the juices of plants, only a few ever have a chance to suck the blood of animals. It may be interesting to know that only the females bite. The males, if they feed at all, simply sip liquid foods, such as fruit juices, water, etc.) How many have ever seen young mosquitoes? (Ask the children to look in rainbarrels and other vessels of standing water for wriggle tails or wrigglers, the young mosquitos.) Some may find mosquito eggs as well as wrigglers. The eggs are laid in little clusters that float on the surface of the water like bits of soap. These will be found in the early morning. In very warm weather, the eggs that are laid early in the morning, hatch into wrigglers by noon, or at least before the middle of the afternoon of the same day.

LESSON 2.—Place the wrigglers in a number of glass tumblers or wide mouthed bottles. Each child should have one. Let the children observe them in the water. (The children may be told that the young mosquito as well as the young of many other insects are called larvae, one is a larva.) How do the mosquito larvae move through the water? Can you find a head and tail end? How do they place themselves when at rest in the water? (Most of them hang head downward, making an angle of about forty-five degrees with the surface of the water. Others may place themselves almost parallel to the surface of the water. If any of the latter are found, the children should know that these are larvae of the malaria mosquito, while the others are the common culex mosquitos.) Does the tail come above the surface of the water? What is the purpose of this? What must all animals do in order to live? (Among other things, the children wil be sure to mention the fact that animals must breathe. This tube near the end of the body is placed above the water, so that the larva may breathe air.) Tie a piece of cheese cloth over the glass and set it aside until the next day.

LESSON 3.—Continue the observation of the larvae. Can you find the eyes or feelers on the wrigglers? Look closely at the body and report what you see. Is it in one piece? Are there any projections of any kind upon it? Do the wrigglers move downward in the same way that they move upward? Jar the glass and watch them. Do they remain at the bottom very long? What do they eat? (The children will probably not be able to answer this question accurately from observation, although they may see some movement of the jaws. The larvae eat tiny one-celled plants and animals that are floating about in the water. Again cover the glass and set it aside for two or three days before continuing the study.)

LESSON 4.—With the glasses again before the children, look to see whether any of the larvae have changed in form. What changes have occurred? (Many of the larvae have changed to pupae. A pupa is dark in color with a thick round portion at the front of the body and a slender segmented abdomen.) Do the pupae move in the water as the larvae did? Do they breathe by sticking the tube near their tails out of the water? (By looking closely the children will see that these little creatures

rest with the rounded portion of their backs at the surface of the water. They will also be able to discover two breathing tubes on the back.) Do the pupae seem to have mouths as the larvae have? (The pupae have no mouths, so although they are active, they do not eat anything.) Again set the glasses aside, but tell the children to watch them from day to day and report any changes that they may see.

LESSON 5.—In a few days the children will find that the pupae have changed into grown-up mosquitos. Look for the pupae skins floating upon the water. (The mosquitos rest on these skins while their wings are developing and drying.) Have the children observe the grown-up mosquitos to see how many things they can find out about them. This is the time to settle the problem as to the number of wings. (The children may be told that all insects having but two wings are placed in one great group called dipters. They will know that the house fly must be a relative of the mosquito.)

LESSON 6.—How may we get rid of mosquitos? Let the children suggest methods? How many mosquitos breed in a single rainbarrel during the summer? Sometimes broken jars and old pails are left standing around in the back yards. These catch rain water and become the breeding places of hundreds of mosquitos. If everyone in the neighborhood should use care in keeping rainbarrels screened and in not alowing rain water to stand anywhere in the yards, the number of mosquitos would be greatly reduced. Put a teaspoonful of kerosene on the surface of the water in a jar in which there are a number of larvae and pupae. Examine them the next day. Why does this kill the wrigglers? (Since the oil spreads out upon the surface of the water, the wrigglers must pierce this film of oil, in order to breathe.) This method is employed in many places where there are shallow ponds and undrained swamps.

LESSON 7.—What are some of the reasons why we wish to get rid of mosquitos? The children should be told something of the work of the malaria mosquito. They have already noticed the difference between the larvae of the common mosquito and the malaria mosquito. The grown-up malaria mosquito differs from the common one in having smoky spots on the wings, which may readily be detected at close range. Scientists have discovered that all malarial diseases, such as ague, chills and fever, and malaria fever, are contracted only through the bites of malaria mosquitos. The cause of the disease is the growth and development of tiny one-celled animals which are so small that they cannot be seen without the aid of a powerful microscope. These small animals develop in and feed upon the red blood corpuscles. They multiply very rapidly in the blood. When a mosquito bites a human being that has these tiny cells in the blood, some of them are sucked into the stomach of the mosquito. Here they pass through another stage of their development, producing a great number of new cells differing somewhat in shape from those that were taken into the stomach of the mosquito. These pass out of the stomach into the blood of the mosquito, and many of them enter the salivary glands. When a mosquito bites a person some of these cells pass from its mouth into the blood and these start the malaria disease. As far as we know, this is the only way in which people may become infected with malarial diseases, so you see if all malaria mosquitoes were killed off, it would mean that no one would ever have any of these diseases.

LESSON 8.—Since mosquitos are such annoying pests, we shall be glad to know that they have many natural foes, that help to keep them in check. How many of the children know the dragon fly? It is sometimes called the snake feeder and snake doctor. This as it flies around through the air feeds almost wholly upon mosquitos. Some people even call it the mosquito hawk, because it destroys so many of these pests. Young dragon flies live in the water in ponds and pools. and feed largely upon mosquito larvae. The larvae have other foes also in the water, among which are the water beetles, giant water bugs, and tadpoles. There are certain birds also that feed upon the grown-up mosquitos, among which are the fly catchers and chimney swifts.

STRAWBERRY. LESSON 9.—How many of the children have strawberry beds at home? When were the plants set out? Did they bear fruit last summer? Tell the children to look at their strawberry plants and be able to answer the following questions: Are the plants grouped together or do they stand singly upon the ground? How do they spread? Find one of the oldest plants and look for runners. How many runners can you find growing from one plant? How long do the

runners become before they send out shoots and roots? How many shoots do you find attached to one runner? Look in the center of the plant to see if new leaves are still being produced. What is the habit of growth of one plant? Does it have an erect stem or does it spread out flat upon the ground or is it in the form of a rosette?

LESSON 10.—For this lesson the teacher should have in class at least one entire strawberry plant with roots and runners still attached? Call for reports of the home study. Verify the statements made by the children by observing the specimen in class. Note carefully the relationship of the roots to the rosette of leaves. Note the number and length of the roots. Ask the children to notice the plants occasionally to determine whether or not the frosts have any effect upon the leaves.

TREES. LESSON 11.—If trees were studied in the spring term, let the first lesson consist of reports of the spring and vacation observations. If no work has been done before, then begin by asking the children to make a list of the different kinds of trees they have in their yards at home. If there are trees in the school yard, begin with simple observations of these following the outlines suggested in April of the fourth year.

LESSON 12.—Have some twigs of the trees you are using as type studies in school. Let each child lay the twig down on the desk, spread out the leaves. Do the leaves overlap? Are the leaves all the same size? Are the stems the same length? Can you tell where the youngest leaves on the twigs are? Examine the twigs to determine how much they have grown this year. How can you tell? (The children will find on the twig some ring scars. These rings show the beginning of the year's growth.) How many years' growth does your twig represent? Compare a number of twigs from different kinds of trees as to the growth twigs have made during the season. This will make an interesting observation lesson outside of school hours.

LESSON 13.—The problem of this lesson is to find out what preparation trees are making for the resting season. Examine a number of twigs. What do you find on them besides leaves? Where are the buds situated? (A bud that is found between the stem of a leaf and the twig is said to be in the axil of a leaf.) Is there a bud in the axil of every leaf? In what other place on the twig do you find buds? (The buds at the ends of the twigs are called terminal buds.)

LESSON 14.—Are any of the leaves beginning to change color? What colors are prominent? What trees have the most brilliant colors? Which ones are almost all yellow? Watch to see whether there are some trees whose leaves simply die and turn brown without having any bright colors. Examine several leaves to see if there is any portion of the leaf that stays green longer than the rest. What is the chief work of the leaf? (The chief work of all leaves is to manufacture food for the rest of the plant. In the fall the plant gradually ceases to make food. As the work stops the green coloring matter in the leaves fade, becoming a bright yellow. Certain chemical changes take place also as the leaves stop work, which causes the brilliant reds, purples, etc.) What else do trees do to get ready for the next season? The children will probably state that they drop their leaves. Have the children observe different trees to find out which ones drop their leaves first.

LESSON 15.—Report on the observation made on the dropping of the leaves. Why do the leaves drop off? (Have several twigs in the room for observation.) Touch gently some of the leaves. Do they drop off easily? Look at the scar left on the twig. Can you see why the leaf could hold on no longer? (A thin layer of bark has grown on the twig under the stem of the leaf and severed its connection with the twig.) The trees have been doing something else in preparation for the resting season that the children cannot see. They have been storing food made by the leaves. The food is stored in the roots, stems, and twigs. What will the trees do with this food next spring? They will, of course, use it in starting the growth of the buds, the new leaves and flowers. Have the children make a list of all the things that trees do to prepare for their resting season and for their renewal of growth next spring.

CARE OF THE STRAWBERRY BED. LESSON 16.—Have the children report on any observation of the strawberry plants since the last season. Has the frost had any effect on the leaves? Do strawberry plants die in the winter? Does the entire plant live over winter? What do we call plants that live from year to

year? (They are perennials. Trees and shrubs are perennials. Many herbs are perennials, although the part above ground dies in the winter while the roots and underground stems continue to live. The strawberry is an herb. It does not have much wood in its stem; in fact, as we remember from our study of the plant, it has very short stems, so that the leaves are attached very close to the roots.) Do you know whether any of the strawberry leaves remain green over winter? Leave this as a problem to be solved later in the term. How may we care for our strawberry plants in order to keep them in good condition for next spring? Let the children tell what is done in their homes. (The plants should be covered with straw, corn stalks, or leaves. This is called mulching the plants.) Why do we cover the plants? The children may think that it is to keep the plants warm. This is not the main object, however, but to keep the temperature even and prevent the ground from freezing and thawing, which is likely to lift the plants slightly above the surface. The mulching also prevents the plants from starting to grow when a few warm days come in the middle of winter, or very early in the spring. If they start to grow and the weather turns cold suddenly, the plants are likely to be injured. When should the mulching be applied? (It is best to wait until the ground is slightly frozen before the mulching is put on the bed.)

NOVEMBER

OUTLINE FOR NOVEMBER. *BIENNIALS.—Turnip or beet as type. Root and leaves of plants grown from seeds in the spring. Roots, stems, leaves and seeds of plants that have grown from the roots that were set out in the spring. Uses of storage of food. Value to man. Sugar beet industry. Comparative study of other biennials.*

Fiber plants. If possible find some help plants. Study fibers. Note strength; similar study of button weed or butter print. Compare flax and cotton. Uses of fibers, cloths, ropes, etc.

Kind of knots. Make a summary of the work done upon the farm during the fall months. What have the children done?

LESSON PLANS—BIENNIALS.—The general thought of the study of biennials is: (a) That the pupils may gain a knowledge of the advantage to the plant of this habit of growth; (b) Value of cultivated biennials to man.

Use the turnip as a type study. Informal discussion of the raising of turnips in the neighborhood. When were the seeds planted? How were they planted? Are the leaves still green? Is this plant a rapid or slow grower?

For the second lesson have in class several turnips, the entire plant. What parts do you find in the plant? (The children will find the round roots with long slender part at the lower end.) Do you find any fibrous roots attached to this slender portion? What do you think is the use of these small roots? Cut the round part of the root in two across the middle. How many distinct structures do you find? (The large central portion is called the central cylinder. The outside layer that separates easily from the center is the cortex.)

Has the turnip any stem or are the leaves fastened directly to the roots? Look closely and you will find that the root narrows at the top into a very short thick stem to which the leaves are fastened. Note the number of leaves. Are the leaves harsh or soft? Do you know any farm animals that like to eat turnip leaves? Examine some seeds of the turnip. What other seeds do they resemble? (Cabbage, radish, and mustard.) Where are the turnip seeds borne? Has any one ever seen the seeds growing on a turnip plant? (It is not probable that many have seen the turnip plant in flower and fruit. If you wish to get flowers you must save some turnip roots and set them out next spring.) Who knows what they will do? They will grow rapidly, send up tall stems with many branches resembling radish stems when its flowers. Soon the rather pretty yellow flowers will appear and these will be followed by pods similar to radish pods and in the pods are the seeds. How many seasons, then, does it take for the turnip to produce its seeds? Any plant that grows from the seed one year and produces flowers and seeds the second year is called a biennial. Do you know what the word biennial means? (*Bi* means two, and *enial* is the same as annual, meaning year.)

If you should examine the root of the turnip after the plant has started to blossom what do you think you would find? Have you ever cut open a radish root

after the plant has gone to seed? If you have you know that almost all the food has disappeared. Nothing is left but the skin and some hard fibers. What has become of the rest of it? Little by little the plant used up the food that was stored in the root to produce the flower and seed. You see then that the habit of this plant is to spend its energy the first year in storing up a vast supply of food in the root. The second year this food is used up in order that the seeds may be produced quickly. We, of course, take advantage of this fact and use the stored up food for ourselves or our stock.

Have the children name all of the other biennials that they know. (Beet, parsnip, carrot, rutabaga, salsify.) Of these the beet is probably the most important. Make a comparative study of the beet and turnip. Have some of the children tell the life history of the beet, starting with the seed and carrying it thru the first season and then the second season until the flower and seed are produced.

Name the uses of all the different kinds of biennials. If possible make a detailed study of the sugar beet and sugar beet industry.

FIBER PLANTS.—In the study of fiber plants find some hemp or butter print. Have in class also some cotton and if possible some flax. See if you can separate the fibers of the bark from the hemp stem. Test the strength of the fibers. Compare the strength of the hemp fibers with that of the butter print. Name all the plants that you know that produce fibers, that are strong and fine and that are of use to man.

What is the special value of the hemp fiber? Ropes are made from this. Make a special study of ropes and cords of various kinds. Have the children bring different kinds of ropes and cords to school. Study them carefully to see how they are made. Note the number of fibers used and the number of strands in one rope. Discuss the uses of ropes and cords about the home. See how many different kinds of knots you can tie.

DECEMBER

OUTLINE FOR DECEMBER. —*If possible have a gold fish or minnow in an aquarium or glass jar in the school room. Locomotion, use of tail, fin, of other fins. How fish breathe, feed, covering of the body. How they find out things; how they spend the winter, common kinds of fish in Illinois. Fishing industry.*

Modern conveniences in the home—kitchen, laundry, cellar, bath, vacuum cleaner, etc. Recognition of different kinds of metal; source, qualities, uses, values of each.

The floor, carpets, rugs, hardwood; care of floors; dangers and treatment of dust. Kind of hardwood used in the home; identification of samples.

A model farm house.

Simple chemistry of cleaning; make soap; solvents for grease, paint, etc. Nature and uses of lye.

LESSON PLANS—FISH.—It is suggested that the study of fish be emphasized most in parts of the state where fishing constitutes one of the industries. Something should be done with fish, however, in any part of the state. A large jar or fish bowl with a gold fish, a minnow, or some other small fish should be kept in the schoolroom.

Have the children attempt to solve the following problems by observations of the living fish. How it moves thru the water. What fins are used most. Shape of the fish. Number of fins. How the fish eats. How it breathes. How it finds out things, noting eyes and nostrils.

Have the children make a list of different kinds of fish that they know. What kinds are found in the streams and lakes of the neighborhood? How are fish caught? Discuss kind of bait used. What is the use of the seine? Of different kinds of net? Discuss the value of fish in Illinois. Reference may be made here to the geography. Are any laws made to protect fish and the fishing industry of our state?

Spend one lesson in talking about how fish spend the winter. The children may not know that some fish, like insects, are inactive during cold weather. They settle down in the leaves and other trash in the bottom of the pond and stay there until spring, eating scarcely anything. Some fish dig little excavations in the mud at the bottom of the pond or stream. Usually two or three huddle together in the hollow and spend the winter there. Most of the large fish seek the deeper portions of

the water where the temperature is not very low and remain somewhat active during the cold months altho probably none of them are as active or eat as much as they do during the summer.

THE MODERN HOME.—The purpose of the lesson on the modern home is to form ideals in the minds of the children of what convenient and sanitary homes are. The lessons may be few or many, at the discretion of the teacher. Discuss the various rooms that should be found in a model farmhouse. What conveniences should the kitchen have? Mention the sink, soft and hard water, etc. Discuss the location of the laundry. How many have seen a laundry arranged in the basement with stationary tubs? What things should be observed in connection with the cellar? Does any of the air from the basement or cellar get into any of the other rooms of the home? If this is true, then should we see that the cellar always has fresh air in it and that vegetables should not be allowed to decay as they sometimes do in the cellar? How is water supplied to various parts of the home?

Who has seen a vacuum cleaner? How is the dust collected? Why is the use of this more sanitary than stirring up dust with a broom?

If practical spend two or three lesson periods discussing the different methods of treating the floors of our homes. Who uses rugs? Who has carpets? Which is likely to collect and retain the greater amount of dust? Who has painted floors? Discuss the use of linoleum in lieu of hardwood floors? Name some kinds of hard wood used for floors. (Hard pine, oak.)

Find in farm papers some pictures giving examples of model farm houses and their equipment.

METALS.—Look about the house for various kinds of metal used in the construction of the house itself and articles used in the house. Make a list of these and discuss the uses of each. Of all of these which do you think is the most useful? Iron, no doubt is the most useful of all our metals. Name the various things used in the home that are made of iron or steel; name other things about the farm used outside of the home.

Discuss the special character of each metal that makes it valuable for the special purpose for which it is used. For example, why is copper better for boilers than iron? Why is silver better for spoons and forks than some of the other metals, etc?

JANUARY AND FEBRUARY

OUTLINE FOR JANUARY.—*Physiology. Food. Why we need food—sources, classes, make collection of different kinds, as starch, sugar, protied, oils, salt. Simple tests for starch.*

Parts of the digestive system. Review briefly teeth as studied in the fourth year. Fluids that help prepare the food in the mouth, stomach, intestine.

Methods and value of cooking foods. Care of foods. How to eat to keep well.

Disease germs that enter the body thru the mouth. What to do to prevent some of these diseases. A simple but clear idea of how germs cause diseases. Effect of alcohol and tobacco upon digestion.

LESSON PLANS.—Depend largely upon the physiology text for facts in connection with the month's work. Make the lessons as practical as possible especially the methods of cooking foods, and how to care for foods that they may be wholesome.

OUTLINE FOR FEBRUARY.—*Physiology. Respiration. Simple study of the composition of air. Organs of respiration, position, breathing movements. Difference between inspired and expired air. How much air we need. How we should breathe. Review ventilation of home and school.*

Diseases that enter the body thru the breathing organs—tuberculosis, pneumonia, colds. What we may do to prevent these diseases—cleanliness, sunlight, disinfectants.

Plans to observe health day.

LESSON PLANS.—Discuss the air of the school room. What are the characteristics of air? Can it be felt? Seen? Heard? What is it made of? The children should know that air is a mixture of invisible gases. About four-fifths

of it is nitrogen, nearly one-fifth oxygen, and a small portion is carbon dioxide and water vapor. Oxygen is the important part of the air, that is, important because we cannot live without a good supply of oxygen. Put a small piece of candle upon a table and light it. Now place a glass jar over this. What happens in a few minutes? Why does the candle flame go out? Because the oxygen in the air is used up by the burning candle.

Study the organs of respiration from your physiology and try to locate each of them in your own body.

Arrange a program for health day. Invite the parents in and let the children read papers or talk about the work in hygiene that they have covered during the month.

MARCH

OUTLINE FOR MARCH.—*Condition of plants at close of winter. Make careful survey of condition of all garden plants, flowering plants, trees, shrubs.*

Blue grass in lawns and pastures. Does it live over winter? Study sod indoors, find underground stem (root stock), roots, shoots. How does it spread? Why is it a good lawn and pasture grass? Seeds, sow some indoors. Care of lawn, preparation, rolling, mowing, etc.

Plan and build a hotbed and cold frame. Study seed catalogs and send for seeds to plant in hot bed or cold frame; cabbage, celery, kohl rabi, cauliflower, pinks, pansies, gaillardia.

Continue study of strawberry plants. Set out new plants.

LIFE IN WATER.—*Frogs' eggs, toads, insects, water beetles, dragon fly, nymphs, etc. Special study of the toad and its relation to man.*

LESSON PLANS.—Make a careful study of plants in the yard, garden and fields. Which ones have lived over winter? Decide which ones have remained green over winter and which ones have lived only in the ground. Are there any trees beginning to show signs of life, or of beginning their work? Any shrubs?

BLUE GRASS. LESSON 8.—Begin with an informal discussion of the various places the children have seen grass growing this spring. (On the lawn, the schoolyard, the pasture, and roadside.) Have the children study the grass in the school yard. This may be done as class work, or the children may make the observation outside of school hours. If practicable, some of the children may be sent out to make observations during their study periods. Note the condition of the grass at this time. What indications have you that it has lived all winter? Upon looking closely the children will find many green leaves close to the ground. Some of the leaves will be half green and half dead. Have weather conditions had anything to do with the number of leaves that have remained green?

LESSON 9.—Compare the grass that is found growing on a southern slope with that on a northern or western slope. If the children find a spot where no green leaves are visible, leave with them the problem whether or not the entire plant is dead. Let them watch the spot occasionally until they are convinced that new plants are springing up. What makes it possible for the plant to do this?

LESSONS 10 AND 11.—Dig up a small sod of bluegrass, wash all the soil from the roots, keep it moist, and bring it into the schoolroom for study. Examine the portion of the sod that grew above ground. Can you make out individual plants? How are these related to one another? Are they far apart or close together? Look at the part that grew in the ground. How many distinct structures do you find? Distinguish the mass of small thread-like roots from the underground stem or slender rootstock. What are the advantages of the rootstock during a severe winter? The plants above ground may be dead, but the rootstock will still live and have its bud all ready to send up a new shoot when warm weather comes. It enables the plant to spread over a larger area. It helps to tide over a dry season as well as a cold one. Have you noticed that the pasture sometimes becomes almost dead in the latter part of summer? When the fall rains come, what does it do? How can it spring up again so quickly? The rootstock with its buds was live and began to grow as soon as it could get enough moisture.

OUT-OF-SCHOOL WORK:—PROPAGATION. What ways are there of starting bluegrass on the lawns or in pastures? By sods and by seeds. If good sod can

be obtained this is the quickest way to get a lawn, but the commonest way is to plant seed. Have the children plant a few seeds in a box in the schoolroom, or better in the schoolyard, and watch the habits of growth of the young plants. See if the children can find out when the sod begins to form. Plant seeds at varying depths. Leave some almost entirely uncovered. Determine which germinate the best. Sow a small plat with pure bluegrass seed, another with bluegrass and white clover seeds mixed. Which succeeds best? Procure several pieces of sod, each about three inches square. Place these in soil about six inches apart. Watch results. What has made it possible for these to cover the ground? Have the children name the characteristics that make blue grass a good pasture and lawn grass. *(Informal discussions and written reports on this work will insure its value.)*

CARE OF THE LAWN.—Everyone likes to see a smooth, velvety lawn. Encourage the children to suggest things to do to keep their lawns at home beautiful. Remove sticks, dead leaves, paper, and weeds. If there are bare spots they should be raked and sown with fresh seeds early in the spring. If the lawn is uneven it should be rolled. Mowing should be done often enough to keep the grass cut close. During hot weather evening is a better time to mow than morning. Why? In dry weather the grass should not be cut too close. Why? (There is danger of exposing the roots to the sun.) (A small bunch of flowering and fruiting bluegrass ought to be put away for schoolroom observation.)

ENEMIES OF THE LAWN.—What are some of the enemies of the lawn and pasture? The children will suggest many. Dandelion, plantain, mole, grubworm, etc. We shall study some of these next month.

HOT BED AND COLD FRAME.—If the teacher has time a discussion of the use of hot beds and cold frames should be given. In some places a cold frame or hot bed may be made. If this is done various plants such as tomatoes, cabbage, sweet potatoes may be raised for the children to take home, or to plant in the school garden.

APRIL AND MAY

OUTLINE FOR APRIL.—*Enemies of lawns and pastures. Weeds. Special study of dandelion—habit of growth, root. Does it live all winter, perennial, leaves, flowers, decide whether it is one flower or many small ones, seed. What makes it a successful weed? Comparative study of plantain, thistle, iron weed, curly dock, etc.*

The mole as an enemy of the lawn. Review grasshopper and crickets in this connection.

BIRDS.—List of birds identified; keep bird calendar; special study of seed eating birds, with emphasis on the sparrow group.

GARDEN.—Care of plants in cold frame. Transplant. Plant other seeds in garden. Plan to raise flowers and vegetables for display next fall.

VACATION PLANS.—Plan to keep a record of all plants grown in the garden. Time of planting, when ready for use. Value of each. Watch for insects on plants. Watch for birds that catch insects.

DANDELION. LESSON 1.—We have noticed that the lawn and pastures have certain enemies to contend with. What are some of the weeds that grow on the lawns? In the pastures? The dandelion is an excellent plant for detailed study.

How many of the children know whether or not the dandelion lives over the winter? Who noticed some dandelion plants when you first studied the blue grass? (The dandelion lives all winter. Sometimes the leaves die and only the part that is in the ground lives.) Have the children observe dandelion plants. Note the habit of growth. What is the relation of the leaves to the ground? Leaves that grow in this fashion are said to have the rosette habit of growth. Where are the longest leaves, at the outer or inner part of the rosette? Where are the youngest leaves? Is the center of the rosette level with the surface of the ground or below it? Are there any advantages to the plant in growing as it does? (The children will readily see that the plants are better protected from wind and cold because of this habit of growth.)

LESSON 2.—Dig up a number of plants, wash off the soil, and bring into the schoolroom. Examine the root. Note how long and thick it is and its direction of

growth. Compare with bluegrass roots. This kind of root is called a fleshy tap root. Has this root any special advantages? Let the children think about this. Do not try to answer it fully now. Have the children pull the rosettes apart, carefully noting what is stored away in the center of each. They will be interested to find numbers of tiny flower buds, some larger than a pea, some as small as a pin head. Determine the average number of buds in the specimens.

LESSON 3.—Flower and fruit. Note the time of the first dandelion flowers, position of flower on the plant, length of flower stem. Note that as the stem lengthens it does not grow straight upward, but first bends outward. Have the children watch to see the flowers close up at night and during rainy, cloudy days. Bring a number of flowers into the schoolroom. Have the children decide whether what they call the flower is a single flower or a cluster of many flowers. Separate the cluster of flowers and look at one small flower. What do you see? (A small seedlike body at the lower part, a cluster of soft hairs above this, and the yellow part, the corolla, with the two "pollen catchers" extending above it.)

LESSON 4.—Have children estimate, by counting the number of flowers in three or four clusters, about how many flowers one plant will produce. If each flower makes one seed, how many seeds will one plant produce? How long after the flowers begin to open until the seeds are ripe? How does this compare with the other plants you know? What is the position of the stem with the ripe fruit on it? What advantage in its standing so tall and straight? Examine the fruit. What part of the flower has opened up into the parachute-like part? What has become of the seeds? What scatters the seeds of this plant?

LESSON 5.—Compare other lawn or pasture weeds with the dandelion. Find plantain, thistle. It will be of interest to make a collection of lawn and pasture weeds.

LESSON 6.—OUT-OF-SCHOOL STUDIES.—Cut off the leaves of a dandelion rosette, leaving the center uninjured. Cut another a little below the surface of the ground. Cut a third about three inches below the surface of the ground. Have the children try these experiments at home as well as at school and report results. They will find that unless the plant is cut off far below the surface it will continue to grow. Have them decide whether or not a lawn mower will kill the dandelions and whether ordinary methods of weeding will do it. Plant a few seeds to determine whether or not they grow the first season. Study a path or some spot that has been trampled upon to decide which can stand trampling better, blue grass or dandelion.

VACATION PLANS. LESSONS 13-15.—Encourage the children to continue the observation of trees during the summer. Also birds, garden, etc., as suggested in the outline.

BLUEGRASS AND DANDELION.—When does the blue grass begin to blossom? Which does the bluegrass head resemble more, oats or wheat? This kind of a head is called a panicle. See if you can find where the seeds are borne. Are there many seeds in one head? Do dandelions flower all summer? Do the leaves grow any higher in tall grass than where the grass is kept mown? Try to work out some of the experiments suggested in Lesson Six.

LESSON PLANS FOR SIXTH YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER.—*Report on vacation studies and observation. Fall aspect of garden, condition of plants started in the spring. Special study of cabbage, kohl rabi, celery.*

Make cuttings of geraniums, coleus or other plants. Care of cutting. Children take plants home.

BUD PEACHES—Study how to make and grow a peach tree.

Special study of cabbage worm; nature and extent of damage done; methods of combating; life history worked out in school room.

VACATION.—Report on vacation studies and observation as suggested in the outline. Make special study of cabbage plant. Discuss how the plants were started in the spring. How the habit of growth differs from other garden plants. What is the cabbage head? Cut one open and find the short stem with the leaves growing out of it close together. The head is like a great bud that never opens. Where do cabbage seeds come from? What must we do if we wish to raise cabbage seeds? Recall the study of biennials of the fifth year. (Cabbage is a biennial.)

CUTTINGS.—Every school should make a few cuttings to keep in the school room, and for the children to take home. For this work you need a few sharp pocket knives, and a box that may be set up on the window sill. A few holes should be bored in the bottom of the box for drainage. Place some clean sand in the box. Soil will do if sand cannot be obtained. Water the sand thoroly and firm it down with a flat piece of board. Make a groove about an inch deep with an old case-knife or stick. Your box is now ready to receive the cuttings.

No plant is better than the geranium from which to make successful cuttings. If there are none growing on the school grounds some person in the neighborhood who has plants will be glad to let you have a number of large branches or entire plants from which to make cuttings. Select the growing tip of a stem or branch. Cut it off three or four inches in length just below a node or leaf. Make one clean, horizontal cut, break off the lower leaves and trim the edges of the upper ones. Why is this done? (This is done to prevent too much evaporation from the leaves.)

Now place the cuttings in the groove made in the propagation box. Place them an inch or more apart so the leaves will have room enough to spread out and get the light. When one groove is full, press the sand close to the stem with your fingers. When all the cuttings are in, water very thoroly so that the sand will be washed up close around the stems. Cover from the light for a day or two with paper. If the cuttings do not come to the top of the box a pane of glass laid over the top will keep the moisture in and at the same time allow plenty of light.

In caring for the cuttings keep the sand moist, but not wet. Allow them plenty of light after the first day or two, but not direct sunlight. If a glass is used over the box, it should be taken off for half an hour each day. Why? (Plants need air and this gives a chance for a fresh supply.)

When the cuttings are well-rooted then comes the lesson in transplanting. Have the children bring pots in which they may place plants to take home. Baking-powder cans, tomato cans, or small lard pails will serve just as well as earthen flowerpots. With a nail make a hole in the bottom of the can. What for? (Drainage.) Have the children bring some garden soil or get some from a field near by. You may use this as it is or you may make an excellent soil for potted plants by mixing thoroughly one part of the garden soil with one-fourth part sand and one-fourth humus, (well rotted leaf mold or well-rotted stable manure.) Have the soil just moist enough so that when you press a handful of it together it will readily fall apart when dropped. Cover the hole in the bottom of the can with a piece of broken flowerpot concave side down, or place a few pebbles or bits of broken crockery or brick in the bottom of the can. Why do you do this? (To allow the water to drain out thru the hole without washing the soil out.)

An old case knife or a small wooden paddle will be found useful in removing the plants from the propagation box. Fill the pot about half full of soil, then

place the plant in position in the middle, and hold it while you put in the soil around it. Press the soil down firmly with the thumbs, water well, and set in a subdued light. After a few days let the plant have plenty of light. Keep it well watered, but do not allow the saucer or vessel that catches the drainage to stand full of water. Why? (This will keep the soil standing so full of water that the air will be shut out, and the roots need air to keep them alive.)

SPECIAL OBSERVATIONS.—When making cuttings, place three or four extra ones in the propagation box for examination. When time for transplanting comes, remove the sand or soil from the ends of these to see what has happened. Has the cut healed? Gardeners say the stem has formed a callus. If it does not form a callus, or heal, it will not grow. Where have the roots come out on the stem? Does it take some plants longer than others to produce roots? Put in several different kinds and note the time required. Why is it better to start cuttings in sand or soil than in water? The plants may form a callus and root in water but they are not as likely to do well when transplanted. The roots must adjust themselves to entirely new conditions, and this they may not be able to do at once and as a result the plant may die.

After the plants have been transplanted, watch the appearance of new leaves. Where? How does the stem lengthen? Where do new branches grow out? How soon do the flowers begin to make their appearance? Have children report in regard to the plants that they have taken home.

Let one pot remain with the same side toward the window for a number of days. Turn the other pots every day or two. Compare. This shows very well how plants seek the light.

If no one can care for the plants in the school room over Saturday and Sunday fill the saucers with water Friday night. This will provide enough moisture till Monday. During the cold weather, if you have no cellar in which to place the plants to keep them from freezing, make thick covers of paper in the shape of cones and slip over the plants, wrapping extra paper around the pots. In this way you may keep your plants a number of weeks even in very cold weather. Do not attempt to keep too many.

The following is a list of plants that are easily propagated by means of cuttings: geraniums, coleus or foliage plants, wandering Jew, salvia, impatiens or balsam, oxalis, sultana, alternanthera, heliotrope.

Have the children try to think out why we use cuttings instead of seeds. They will readily see the following advantages of propagating by means of cuttings instead of seeds; (a) they get quicker results; the plants are ready to flower in half the time; (b) they are certain to get the same kind of plant as the parent while if seeds are used they may get one color or variety when they expected another.

OCTOBER

OUTLINE FOR OCTOBER.—*Identification of garden weeds; weed herbarium. Birds as weed destroyers. Review native sparrows.*

Find blackberry and raspberry canes that have borne fruit this year; new canes. Pruning; why necessary? How do raspberries spread? Blackberries? Make cuttings of grape; study varieties of grapes; habits of growth, how and when to prune. Relatives of grape.

GARDEN WEEDS.—Have pupils look in the garden for different kinds of weeds. As far as possible get the names of the different kinds. Make a special study of one—as the purslane. Note its habit of growth, close to the ground. Note the space that one plant covers. Bruise the stem to determine whether or not it has much moisture in it. Pull up a plant and let it lie in the sun for a day. Does it wilt as much as some other plants, when left in the sun? Why? Find the flowers if there are any left. Note size and color. Look for the boxlike seed pod. Open up the box and find the seed. How many pods on one plant? Count the seed in one pod. Can you estimate how many new plants one of these weeds will start next year?

In a similar manner study several more garden weeds. Let each child begin a weed herbarium. Press the weeds and when they are perfectly dry paste them upon paper or card board. Each specimen should show a part of the stem, the leaves, and a few seeds.

Make a detailed study of the raspberry and blackberry as suggested in the outline.

GRAPE CUTTINGS.—The work should be done the very last part of the month when the vines have dropped their leaves. If the class has not already made a detailed study of soft-wood cuttings then as a preliminary lesson soft-wood cuttings should be made with a study of the callus, rooting, and transplanting.

Grape cuttings are made late in the fall or early winter when the leaves have fallen off, and the plant has ceased work for the winter. Cuttings made from hard wood at this season are called dormant cuttings. Will you want old wood or new for the cuttings? They should be made from this season's growth. Measure some of the stems to determine the length of growth in one season. Do these stems vary in thickness?

How many buds on one stem? How arranged? Remove from the vine a number of branches. Make a slanting cut through the joint or node where a bud is attached. To do this place the knife on the side of the stem opposite the bud and on a level with the top of it. Now cut slanting downward and the knife will come out just below the bud. Make one clean cut; it must not be jagged. Each cutting should have at least two good buds.

What will you do with your cuttings? Tie a number together and place them in moist sand in a cool place, or they may be buried in the soil of the garden. If this is done care should be taken not to put them where they will stand in water. What do you want the cuttings to do during the winter? Just what your soft-wood cuttings did, form a callus and start roots.

NOVEMBER

OUTLINE FOR NOVEMBER.—*Collections and study of pebbles, minerals, rock specimens, glacial evidence, fossils; origin of soils; identification of sand, gravel, loam, clay, silt; experiments in letting these settle in dish of water. Characterize local soils. Value of farm lands and of village building lots. Drainage; ditches; tile. Diagram showing drainage plan on home farm. House and cellar drains; distinctions between drainage and sewer tiles.*

A STUDY OF PEBBLES.—LESSON 1.—In preparing for this lesson the teacher should ask the pupils to look for pebbles or small bits of rocks and bring them in. If there is a stream in the neighborhood collect some of the pebbles from its banks and bed. The teacher should have on hand a collection of pebbles of various kinds. Let the children examine the pebbles brought in and compare them as to shape. Are they all the same color? Are some rounder than others, some smoother? Try scratching a number of the pebbles with a sharp nail. Do some scratch more easily than others? Put together all that are similar in color. Do you find any that seem to be made up of more than one kind of stone?

LESSON 2.—Where do the pebbles come from? Some of the children may have found pebbles in the soil of the gardens, or fields, some near streams. Are pebbles which are found in the banks and bed of streams smooth or rough? Are they round like a marble or flat? How did these pebbles come there, and why are they so smooth? If we go up a stream to its source in the hills do you think we should find as many small, smooth pebbles there? In most streams we should find near the source large pieces of rock that have broken from the hillsides and bluffs and fallen down into the stream. In fact, the bed of the stream here, we should find, is made up almost altogether of these great pieces of rock. Can you imagine that these great pieces of rocks are the beginnings of the small pebbles? These pieces are broken into smaller and smaller pieces by tumbling upon each other and by the action of frosts. At this time they are rough, angular, and square cornered. How do they become so small and smooth? To answer this put a few broken, sharp-cornered pieces of stone into a thick bottle, cover with water, put in the stopper, and let the children take turns shaking this vigorously. After a number of minutes notice what change has taken place. Why is the water muddy? What has been happening to the pieces of rock? (In striking against each other they have been wearing away little by little and the tiny particles caused the water to become muddy.) That is just what happens to the rocks in the stream. The rocks strike against each other and slowly grind off the rough places and sharp corners. The farther down the

stream we go the more they are worn and the smaller they become. Finally, after many, many years, there is nothing left but the pebbles.

LESSON 3.—Have the children tell the story of a pebble starting at the source of the stream with a great piece of rock and following it step by step as it goes down the stream until it becomes a small pebble. Be sure to have them realize the great length of time necessary for this change. In many cases it takes thousands of years to make a pebble out of one of these pieces of rock.

LESSON 4.—Some pebbles are made by the washing back and forth of waves on the shores of lakes and seas. As the waves dash upon the shore and then run back into the sea the pieces of stones are rolled back and forth and grind each other in much the same fashion as they do in the river. Which do you think would probably make the rounder pebble, the sea waves or the river? (The children will readily see that the rolling back and forth is likely to result in a round pebble rather than a flat one.) Some of the pebbles we find may have been formed in another way. Any pebbles or stones that have scratches on their surface have quite another story to tell. Who knows what a glacier is? Your geography tells you something of the glaciers of Switzerland and Alaska. Glaciers, as we know, are made up of the great masses of snow which pile up year after year until they are many, many feet deep. The snow is pressed down until it forms a crumbling sort of ice on the slopes. This great mass of snow and ice moves slowly down toward the valleys becoming harder and more like real ice all the time. When this reaches the valley it still flows along but so slowly that we could not see it moving if we watched ever so carefully. It does not move more than two or three feet during an entire day. As the glacier moves along it picks up pieces of rock and pebbles carrying them along with it. Some of the pebbles carried by the ice pass over other pebbles or pieces of stone and in striking against each other little scratches are made, and the stones are gradually worn away. Whenever you find a scratched pebble you may know that ages ago glaciers moved over the country carrying rocks and clay, mud and pebbles with them. Here in Illinois we have evidences that thousands of years ago there were a number of these glaciers.

LESSON 5.—Have the children summarize all the ways in which pebbles are made; those made by the streams, by the waves of sea and lake, and by glaciers. Examine again the pebbles that you grouped together because they resembled each other. Why do you find a difference in these pebbles? Do you suppose that they were all of the same kind of rock to begin with? We have already found that some were harder than others. That means that they were harder in the beginning. Some were probably granite, some sand-stone, some limestone, and some of still different kinds of rock. What else do we find in the bed of a river besides pebbles? (The children will, no doubt, mention at least gravel and sand, perhaps some will also name mud and clay.) How did the sand and gravel come there? Do you suppose that they, too, are broken rock? Tell the children to bring in samples of sand and gravel, also some soil from the gardens and fields.

ORIGIN OF SOIL.—LESSON 6.—We shall now try to find out just how this soil was made. Try to have the children think of a time ages and ages ago when there was no broken up rock on the earth, no sand or gravel or soil of any kind. At that time we can think of the surface covered with solid rock wrinkled and ridged into mountains and valleys. Now we find almost everywhere, except in the mountains, a covering of soil.

Can you think of all the agents that helped to break up the soil rock of the earth and make it fine enough for plants to grow in? We have already spoken of the work of glaciers, of water in streams and of waves on the shore. All of these agents helped to make sand and gravel as well as pebbles. But some other things have helped also. What happens to a wagon tire when a blacksmith heats it? Does it grow larger or smaller? When he puts it on the wheel what does it do as it cools? (The iron expands when it is hot and contracts, getting smaller, when it is cool.) Many rocks are affected in the same way but often in cooling they crack. Did you ever happen to spatter a drop of cold water on a hot lamp chimney? Why did it break? (The cold water caused the glass in that one spot to contract so suddenly that the little particles of glass could not stand the strain of being pulled away from the rest and so it broke.) Frost or freezing is another way in which rocks are broken. Did you ever have a glass broken because it was full of water

and you left it out where it could freeze? What made it break? (Water in freezing expands, occupies a much larger space. The force of this expanding water broke the glass). When water gets into cracks and crevices of rocks and then freezes what is certain to happen? Does freezing help in any way to break up clods of soil? Try this experiment. Make a ball of garden soil by moistening it and working it like dough, put it on the stove and let it dry then pour some water over it and set it out of doors where it will freeze. What is the effect of the freezing?

LESSON 7.—Let the children enumerate the agents they named in yesterday's lesson that helped to break up the rock. Rain, wind, and snow also help to decay rock and cause it to fall to pieces. Plants, too, help very greatly in breaking up rock. Sometimes the roots of trees penetrate the small crevices in rocks and burst them asunder. Plants grown in the soil help to make it finer because of an acid that they give out from their roots which dissolves particles of soil. There are also some little organic bodies in the soil that are working all the time wherever plants are growing or vegetation decaying to make the soil finer.

LESSON 8.—Have the children place on a piece of white paper a small amount of gravel, sand, clay and garden soil. Which is coarser? Are all the little pebbles in the gravel round? Is there any coarse sand in the gravel? Look carefully at the sand. Are all the little grains the same color? Rub a little of the sand between your thumb and finger. How does it feel? If you have a lens look at the particles. Do you find any that have sharp, jagged edges? These are small bits of a very hard rock called quartz. None of the agents have been able to break them into smaller pieces. Test the clay in the same way. How does it feel? Can you find any shiny particles in the clay? In the same way examine the garden soil and decide whether there are any shiny particles that resemble those of the sand in that? What else do you find in the garden soil that you do not find in any of the others? (Bits of decayed plants will probably be found.) Do you think this soil has anything more in it than broken up rock? (This dark fine material that you find in the garden soil is called humus. This is vegetation that has been changed by the action of air and water and little living organisms that we call bacteria.) Do you know what we call soil that has this material in it? (It is called loam.)

LESSON 9.—For this lesson you will need four glass tumblers and some sand, clay, gravel, and loam. Fill the tumblers almost full of water. Place a tablespoonful of sand in one tumbler, gravel in another, clay and loam each in the others and stir thoroughly. Watch carefully to see which settles first. Let them stand for some time. In which does the water become clearest? In which does it remain muddiest? Stir them all again. Let them stand about two minutes, then pour off all the water leaving the settlings in the bottom. Set aside for the next day's lesson.

LESSON 10.—Examine the soil that was left in the bottom of the glasses from yesterday's experiment. In which do you find the most grains of sand? Let the children try this experiment with the different soils brought in from the different farms in the neighborhood and determine whether or not some of the soil contains more sand than others.

When the loam contains a high percent of sand we call it sandy loam. When it contains a great deal of silt we call it silt loam, and when it has a high percent of clay it is known as clay loam.

Let the class try to determine what kind of soil is common in the district. (There are a number of different kinds of soil in Illinois. Among these are prairie brown silt loam, black clay loam, yellow clay or silt loam, brown sandy loam, peaty swamp lands, sandy hillside loams. The teacher will find Bulletin No. 123, Fertility in Illinois Soils, an excellent aid in determining the kind of soil in different parts of Illinois. This is published by the Agricultural Experiment Station at the University of Illinois.)

LESSON 11.—Does the kind of soil have anything to do with the value of land? Is pure sand or pure clay as valuable as land that has a high per cent of humus in it? What is the value of land per acre in your neighborhood? Are there some other things besides the kind of soil that we must consider in estimating the value of a farm? (Let the children name some of these. Among others the drainage should be mentioned.) Why is drainage necessary? (In order to understand this we must know something about the water in the soil.) Where does the water in

the soil come from? (Rain either directly or indirectly supplies all of the soil water.) What becomes of the rain that falls upon the earth? Ask the children if they have ever observed the rain during a heavy shower. Some of it runs off, some evaporates, and some sinks into the ground. The last is called ground water. Spend some time discussing the story of a rain shower.

LESSON 12.—We shall try an experiment to show what becomes of the water that sinks into the ground. Place a number of pebbles or gravel in the bottom of a tumbler. Cover this with a piece of cloth then fill the jar with fine soil from a field or garden. (The cloth is put in simply to keep the particles of soil from filling the spaces among the pebbles.) Pour some water on the soil. Watch to see what it does. As it soaks into the soil can you see it between the particles? Pour in more until you see the water standing in the spaces among the pebbles in the bottom of the glass. When the rain falls upon the ground it does just what this water did. It percolates slowly downward thru the soil till it is stopped by a layer of clay or solid rock, just as the bottom of the glass stopped this. If it keeps on raining what will happen? Pour more water into the glass until it stands on the top of the soil. Does this ever happen in the field? Are all the spaces between the small particles filled with water now just as the spaces in the bottom were at first? Set the glass aside until the following day.

LESSON 13.—Examine the glass to determine whether any water is left between the spaces. What has become of the water near the top of the soil? Water that completely fills the spaces and moves slowly downward by the force of gravity is called free water. Plants do not use this free water. Determine by looking at the glass how much free water remains. Have in class some soil that is slightly moist but not soaked with water. Have the children handle this and determine whether or not it contains moisture. Where is the moisture in this soil? (This is called capillary water and it is in little films around the particles.) Put a smooth pebble into some water. Take it out and you can see a layer of water around it. This shows how each tiny particle of the soil holds a film of moisture even when there is no free water standing among the particles. Capillary water is that which is used by plants.

LESSON 14.—Since the plants do not use free water we must drain it away from the surface. How is it drained? Have the class report the different methods of drainage used in the district. Who has seen an open ditch? How deep is it? How wide? Is it ever full of water? Does the water flow along swiftly in it? Does it ever become dry? Is it ever necessary to clean it out? (Fine soil washes into the ditch little by little from the adjoining fields during heavy showers. This settles to the bottom and necessitates the cleaning of the ditch at least once in two years. In some places it must be cleaned once every year.) Who has tile on their farms? Drainage by means of tile is called under drainage. Do you think of any reasons why this is better in most places than an open ditch? (The children will probably be able to name a few of the advantages of the tile over the open ditch. The soil above may be cultivated, hence there is less waste of ground. When tile is properly laid it will last for years and therefore needs no attention as the open ditch does. Have a tile in class. Who has ever seen tile laid? What are important things to consider in laying tile? (The slope must be watched carefully in order to have enough fall so the water will slowly drain off.) What are tile made of? (Perhaps some members of the class may have visited a tile factory and will be able to tell how tile are made. They are made of a certain kind of clay and then are dried carefully in large kilns something as brick are dried.)

LESSON 15.—Does the kind of soil in any way affect drainage? To answer this question we shall try the following experiment: Procure five straight topped lamp chimneys. Tie firmly over the top of each a piece of cloth. Fill the chimneys with different kinds of soil. Put sand in one, clay or silt (common yellow clay) in another, loam in another, a mixture of half sand and humus (well rotted manure, or leaf mold) in another, clay and humus in another. Firm the soil by jarring the chimneys gently up on the table while they are being filled. Have some boy make a rack for the chimneys by boring or cutting a hole for each in a board. The hole should be large enough to allow the chimneys to slip thru to the large portion near the base. This board may be nailed to two uprights or be set on two blocks so that a pan or some sauce dishes may be placed under the chimneys to catch the drip-

pings. Measure a definite amount of water, pour it slowly into the sand. Note the length of time that transpires until the water begins to drip below into the dish. Keep a record of the amount of water you pour in. Do the same with each of the other chimneys. Decide which drains most readily and which retains the most water. What kind of water dripped from the soils? This was, of course waste free water and in the field should be drained off by under drainage. Does humus aid the clay in allowing the water to pass thru? What was the effect of putting humus into the sand? Are the soils still moist after the water has stopped dripping? What kind of water is this? (The children will probably remember that this is capillary water.)

LESSON 16.—Ask each child to report just where tile is laid in his father's farm. Where does the tile begin and where does it end? Are there any low spots in which free water stands part of the time? If you could trace the water in a string of tile where would it finally be found? Water from tile may be traced to the ocean. It goes from one tile into another, a somewhat larger, possibly, into an open ditch or into a small stream. This flows into a larger stream or into a river which finally, thru other rivers, reaches the ocean. Have each child draw a square or rectangle representing the home farm and with dotted lines show the strings of tile on the farm. Indicate by shading or in some other way the highest portions of the farm and the lowest.

LESSON 17.—Examine the tile that you have in class. Is it porous? Stand it in a pan of water to see what happens. Will the water soak thru the tile? Lay the tile down on one side and place on top several layers of cloth (an old towel folded into a thick wad will serve). Saturate the cloth thoroughly with water and keep it wet. After a few days examine to see whether or not the water has soaked entirely through the tile. How, then, does water get into the tile in the field? (Some goes in between the tiles while some soaks through the porous tile.) How far on each side of a string of tile may be drained by it? (That depends, of course, upon the amount of water in the soil, the slope and other conditions.) The children will probably see that, since there is less pressure of water in the tile than in the surrounding soil the movement of water for several feet or even rods on either side will be toward the tile.

Who has ever seen a sewer tile? If possible have one of these in class and compare with drainage tile. Can water soak thru this? The children will readily see that the glaced surface prevents water from going through. How are the ends laid so that they may fit closely together and prevent the water from going out or in at the joints? What is the use of sewer tile?

DECEMBER

OUTLINE FOR DECEMBER.—*Weather; keep record for the month. Study effect of weather upon plants, animals and man.*

Water supply of home and school. Various types of wells and pumps; windmill. Methods of getting water to stock and to house; city water supply. How drinking water may become impure or dangerous; how typhoid is spread. Value of individual drinking cups.

LESSON 1.—The weather is so closely related to our lives that it is one of the most important nature study topics. For this reason some time should be given to making weather observations, drawing conclusions and noting the effects of weather upon plant and animal life. Discuss with the children what the term weather means to them. The discussion will probably bring out ideas of heat, rain, drought, snow, cold, clouds, winds and storms of various kinds. Has the weather had any influence upon work done on the farm during the fall months?

LESSONS 2 AND 3.—Arrange a plan for keeping a daily report of the weather during the month. Let each child place in his note book or on a sheet of paper the following chart making a place for each day in the month.

WEATHER RECORD

Date	Hour.	Temperature.	Wind Direction.	Velocity.	Sky.	Precipitation or Rainfall.	Remarks.
Dec. 1	9 A. M.	Warm, 40°		Light	Partly Cloudy		Snow this P. M.

These observations may be taken without instruments. However, if the school has a thermometer then the temperature should be reported in degrees. If there is no thermometer then the terms warm, hot, very hot, cold, very cold, and chilly, may be used. The direction of the wind may be indicated by an arrow. An arrow pointing toward the top of the chart indicates a wind that is traveling northward. Is a wind named from the direction it is going or the direction from which it is coming? What is meant by the velocity of the wind? (Velocity means the distance the wind travels per hour.) The following words may be used to indicate the velocity of the wind. These terms are suggested by the U. S. Weather Bureau. Calm, when there is no perceptible wind; light, when wind enough to just move the branches of the trees; brisk, when swaying branches; high, when swaying whole trees. Under sky record whether it is clear, partly cloudy, or overcast. Precipitation means falling weather of any sort—rain, snow, hail, etc. Under remarks report any item of interest that does not appear under the other headings. Thus, for December 3, a heavy frost last night, or for December 16, a slight snow fell this afternoon.

LESSONS 4 AND 5.—What is the effect of cold weather upon plants? Ask the children to observe plants along the road-side, in the gardens, pastures, meadows and fields. Are any of them still uninjured by frosts? Have any been killed? The children will find that some plants are still green. What does this mean? Some plants are much harder than others and are able to stand a temperature below freezing. Others are so delicate that the slightest frost kills them. Have the children make a list of hardy plants that they find, and the delicate ones. Are any plants found that have finished their work, produced their seeds, and died before there were any hard frosts? Make a list of these plants. Observe the trees in the neighborhood. Do some of them get ready for cold weather before others? Are there any trees that still retain their leaves? Any with leaves that are green?

LESSONS 6 AND 7.—The effect of cold weather upon animal life. Ask the children to look carefully for insects along the road-sides. Are there as many as there were in the fall? What has become of them? (Many, like some of the plants, have died because their life work is done.) Do you think any are hidden away for the winter? (A few have crept under leaves and other objects and will sleep during the winter months.) Are there as many flies about the home and school as there were earlier in the season? What has become of them? Have you noticed any fastened to the ceiling or walls quite dead? Have you found any alive in cracks and crevices? Do you know whether or not house flies live as grown up insects over winter? If you keep your eyes open you will find on warm days even in the middle of winter, some flies coming out of their winter quarters and buzzing around on the window panes. They, like some other insects spend the winter in the grownup stage. They hide away in some sheltered nook and become dormant. That is, they remain in a sort of stupor and do not eat anything for months. We say that they hibernate for the winter. In the spring they come forth and start a new generation of flies for the next season. What should we do, then, with every fly that we find crawling around in the winter time?

If you pull pieces of bark from posts or logs you will discover where a number of insects and spiders hibernate for the winter.

How does the cold affect the domestic animals? Are the coats on the horses and cows any thicker than they are in the summer time? Do these animals require any different food or care during this season? Do you know any wild mammals that hibernate during the winter months? (While the children in Illinois have never seen any of these animals they have probably read of the bear which hibernates during the winter.)

Are there as many birds here during the winter as in the other seasons? What has become of them? (Many of them have taken on the habit of moving southward at the approach of the winter season.)

LESSON 8.—Spend some time discussing what effect the weather has on ourselves. Effects of cloudy weather? Fair? Cold? Hot? etc. Do you feel more like working on some days than others simply because the weather is fair? Have the children think of all the different things we do to protect ourselves from the weather, such as shelter of various kinds, houses, clothing, making of fires, etc. Lead the children to see that if it had not been for weather the people ages ago probably would never have thought of building houses. Now we build our houses for other reasons than simply to have a protection from the weather, but after all this is the main reason for having houses.

LESSON 9.—At the end of the month have the pupils make a short summary derived from their observations. How many fair days? How many cloudy? How many in which there was precipitation? What was the general direction of the wind for the month? What was the direction of the wind when the temperature was warmest? When the temperature was coldest? From what direction did the rain come? From what direction did the snow come? What was the direction of the wind during the cloudy weather?, etc.

Have them note other relations. Is a cloudy night warmer or colder than a clear night? You often hear people say in the early fall: "If it clears it will freeze tonight." Can you see why this is true? After you have studied radiant heat, you will understand better how the clouds act as a screen to keep the heat close to the earth. Which seems colder, a windy day or a calm one? Why?

LESSON 10.—WATER SUPPLY OF HOME AND SCHOOL.—Review the source of water in the soil studied in November. Ask each child to report upon the source of water used about their homes. Let each child tell the number of wells they have on their farms. Who have cisterns?

LESSON 11.—Discuss different kinds of wells. Who have dug wells? How deep are they? How wide? With what are they walled up? Why is it necessary to wall up a well? Where does the water come from in one of these wells? You remember that in the lessons on soil we found free water standing among the spaces in the soil. If we dig a hole in ground that is saturated with water what will happen? How high will water stand in the well? (It will stand as high as the free water stands in the ground.) As the free water percolates farther down in the soil what will take place in the well? (The pupils will readily see that the water in the well will always be on a level with the free water in the ground.) Why do wells of this sort go dry during the drought of summer? These are called shallow wells.

LESSON 12.—Some dug wells are much deeper than those known as shallow wells. Some are thirty, forty, or even fifty feet deep. Has any one a well of this sort? Does it ever go dry? In wells of this sort the supply of water comes from what is called a vein that remains practically constant for years. Have the children try to get a clear picture of what a vein of water is. If we should dig down twenty, thirty, or forty feet would we find the same kind of soil all the way down? The children will be able to answer from their geography work that various layers are found, sometimes a layer of sand, then of silt, or clay, or even solid rock. Are all the layers parallel to the earth's surface? (In some places instead of being parallel they are oblique or even wavy.) Let some child pass to the board and draw a waved line to show a layer of clay a number of feet under the surface of the ground. Above this draw another line representing a layer of sand. Above this another of clay and then sand or some other soil reaching to the surface. Let us suppose that the layer of sand farthest down slopes so that it comes to the surface many miles away. If it rains on this surface what will become of the water? (It will, of course, percolate downward thru the sand.) Why does it not go on down thru the clay? You remember in the experiment with the clay in the lamp chimneys that it took a long time for the water to move downward thru this. It is the same in the ground. So the sand becomes filled with water. Now if we dig a well down into this layer of sand what will happen? The children will see that the water will fill the well standing as high as the water stands in the layer of sand which comes to the surface miles away.

LESSON 13.—Are there any driven or drilled wells in the district? How deep are they? How are they made? Some of the boys will no doubt be able to describe the digging of a drilled well. With what are these wells walled? (Usually with a galvanized pipe very much like a gas pipe.) In driven wells the pipe is driven into the ground as the hole is made. In the drilled well the soil and material are taken out of the well and the pipe put down afterwards. Usually then, the drilled well has a little wider pipe than the driven well. In Illinois most of the deep wells are drilled. Where does the water supply come from in these wells? It is supplied in much the same way that it is in the deep dug wells, only the layer of sand containing the water is much farther down in the ground. In some cases these wells are two hundred feet deep. Sometimes the water in one of these drilled wells rises almost to the top of the well. Can you explain why this is so?

LESSON 14.—Which of the wells discussed do you think is likely to afford the purest water? (The drilled well is usually free from all bacteria that are likely to be present in shallow wells.) Why? We have only to think of the water percolating thru the soil to know that this water may carry with it different kinds of bacteria that are dangerous to human beings. Water may come from some outbuildings or from barns or other places where it is certain there are germs of disease. It has been proved beyond doubt that typhoid fever germs are frequently found in shallow well water. Did you ever see any one washing his hands at a pump and letting the water from his hands run down upon the cover of the well, some of it going back into the well? Sometimes we take a drink at a pump and throw the water that is left where it may run back into the well. May a deep dug well also have bacteria carried into it by the free water in the soil? (It certainly may if it is walled all the way with brick. You can easily see that the water near the surface may make its way thru the soil into the deep well.) Can you think of any way in which this may be prevented? Some people finish the upper five or six feet of a deep well with cement. They make this cement wall extend five or six inches above the surface of the ground. They see to it, also, that a tight cover is kept over the well. In this way you see the water from the deep vein only enters the well. This is usually free from bacteria.

LESSON 15.—How is water obtained from the wells at home? Who has a lift or suction pump? Has any one an old-fashioned chain pump? Are there any wind mills in the district? How does a wind mill pump water? Have the children name the parts of the wind mill. (Tower, wheel, weather vane, and a governing device to regulate the movement of the wheel so it will not move too rapidly when the wind is high.) How is the wind mill fastened to the pump? (In most cases there is a rod or shaft that is attached to the piston rod of the pump. As the wheel turns in the wind the piston of the pump is moved up and down.) What arrangements are made so that a quantity of water may be stored for the stock? How many have a wooden tank or trough? Who has a galvanized iron one? How is the water carried into the home? Let the children report on this. Has any one a storage tank placed high enough so that the water may be piped into the house? Many farmers are placing storage tanks somewhere near the house so that the water may be piped to any part of the house. Do you not think this is a great improvement over carrying in pails all the water that is needed? Who has a cistern pump in the kitchen? Does any one use cistern water for all purposes about the house? Has the cistern a filter? Do you know what a filter in an ordinary cistern is made of? Some cisterns have a filter placed in the ground outside the cistern made chiefly of charcoal. The water from the roof passes through the charcoal before it goes into the cistern. The charcoal absorbs much of the impurities from the water. Some cisterns have a wall of brick built about half way up in the middle, the water passes into the cistern on one side and passes through the wall and is used from the other side. Do you think filters of this sort will remove bacteria from the water? (They do not. They simply remove dust particles and make the water clearer, but bacteria, if there are any, pass thru the filter.)

LESSON 16.—How is the school supplied with water? If there is a well is it arranged so that any surface water can get into it? Do all the children have individual drinking cups? Why have so many state legislatures passed a law that there shall be no public drinking cups? (This has been done because these men believe that there is much danger of contracting diseases from the public drinking

cup. If some one with tonsilitis, for example, should drink from a cup probably some of the germs would remain on the edge of the cup. The next child who drank would be likely to get some of the germs and contract the disease.) Do you keep a pail of water uncovered in the school room? Why is this not a good thing to do? Dust of various kinds and germs from the air are likely to settle in it.

LESSON 17.—A lesson on the value and importance of water about the home will be worth while. Let the children suggest all the uses of water that they know about the house and barns. Discuss its important connection with the growing of plants in the fields and garden.

JANUARY

OUTLINE FOR JANUARY.—*Systems of lighting in the home and school. History of lighting. Candles. How made. Study of a candle flame. Necessity of air (oxygen). Parts of the kerosene lamp. How the kerosene lamp burns. Different kinds. Nature and uses of kerosene. Petroleum and its products.*

The eye. Parts of the eye. Muscles; tear gland; lids; lashes; eyelashes, etc. Kinds of light best suited to the eye. Danger of reading in a strong light or by twilight, when lying down, when the eyes smart; diseases of the eye; how to prevent; testing of eyes. Simple review of the use of food and of respiration.

LESSON 1.—Have the children name all the different methods of lighting that they have in their homes and the school. Discuss briefly the history of lighting. Have the children think of a time in Illinois when people were dependent largely upon light from the fire place or from pine knots. Later they used candles. Sometimes they used a simple lamp made with a cup in which grease was placed with a piece of old toweling twisted to form a wick. Tell the children to ask their grandparents to tell them about these simple grease lamps. How were candles made in those early days. Perhaps some one in the neighborhood may have some old candle molds which will add to the interest of this study. The children should know that at first all the candles were made by a method called dipping. The strings for the wicks were tied to a stick a foot or two in length. Beef tallow was melted in large kettles. The strings were dipped into the hot tallow then taken out and allowed to stand for a few minutes until the tallow hardened, then they were dipped in again just for a moment. This was repeated again and again until the candles were large enough for use. You can imagine how long a time it took during the winter to make enough candles to last the family for a whole year.

LESSON 2.—The other method of making candles was by means of the candle mold. Tell the children how this was done. If you have no mold, pictures will help if they are available. Tell the children how our grandmothers strung the molds passing in the wicking with large darning needles. The wicks were tied fast with a small stick which was laid across the holes in the top of the mold and then the hot tallow was poured into the mold and allowed to cool. When cold, hot water was poured over the outside of the mold to loosen the candles, which were then pulled out by the sticks. Candles are made in the same way today, but most of our candles are made of paraffin instead of tallow. The teacher should have a few candles for the children to examine.

LESSON 3.—For this lesson a candle or a portion of a candle is needed. Light the candle and notice how it burns. After is has burned a short time notice the shape of the top of the candle. What is in the hollow cup? What forms the sides of the cup? Does the flame come down to the surface of the tallow? Where is the flame widest? What is the shape of the flame at the top? When the candle has been burning for some time blow out the flame. Can you see anything coming from the end of the wick? What is the color of the smoke? What do you think this smoke is? Let us try to answer this by thinking of something in the home and that is a teakettle full of water. When the water begins to get hot what can you see coming from the spout of the teakettle? What was the steam a few minutes before? The children will no doubt say that the steam was first water. The heat changed the water into steam or vapor. Think what effect the heat has upon the melted paraffin in the wick of the candle. It changes it into vapor. Now look at your burning candle. In how many forms do you see paraffin? The children should be able to see paraffin in three forms, solid, liquid, and vapor.

LESSON 4.—Will the paraffin vapor burn? Light the candle as you did in Lesson 3. Now blow out the flame. Have a lighted match ready. The minute the flame is out apply the lighted match to the smoke or paraffin vapor. Does it take fire? Watch to see how it burns down to the wick and light the candle. Try this a number of times until you are certain that the vapor takes fire and burns. What is it, then, that is really burning in the candle? The children will probably be ready to say that it is the paraffin vapor. Let us name, then all the things that happen in the burning candle. The heat melts the paraffin, the melted paraffin goes up through the wick and is there changed into vapor and then burns.

LESSON 5.—What else is needed to make the flame of the candle? Place a small piece of candle upon the table. Light it. When it is burning brightly place a fruit jar over it and watch to see what happens. Take the fruit jar off, light the candle again and place a tumbler over it. Does the flame go out any sooner under the tumbler than it did under the jar? What was in the jar and the tumbler before you turned them over the candle? (You may have to help the children to see that they were both full of air.) Why did the flame go out? (It was luck of air that caused the flame to gradually die out.) Can you have any flame without air? The part of air that is necessary for a flame is called oxygen. What are the two things then that make the flame of the candle? (Paraffin vapor and oxygen.)

LESSON 6.—For this lesson you need a kerosene lamp. Have the children, with the lamp before them, name the parts of the lamp; bowl, wick, burner and chimney. Light the lamp and put the chimney on. Watch the flame. Is it steady? Blow out the flame and let it stand for a few moments then remove the chimney. Relight the lamp and leave the chimney off. Is the flame as steady as it was before? What then, is one use of the chimney? Do you think it is the kerosene vapor that burns? Try the same experiment that you did with the candle to see if the smoke that is coming from the wick will catch fire. Do you think air is as necessary as it was for the burning of the candle? Can you see any way arranged for the air to get to the burning wick. The children will easily find the perforated bottom in the burner where the air enters. Trace the air through the chimney up to the flame. To do this light a small splinter of wood, let it burn for a moment then blow out the flame and hold the smoking splinter at the lower part of the burner. You will be able to see the smoke moving upward through the perforated base. Now hold the smoking splinter at the top of the chimney and you will see that the currents of air are moving outward at the top. Can you see what the cap of the burner does? If you will loosen the cap a little and light the lamp you will see that the light is smoky and dim. The cap helps to direct the air toward the flame. You will see it is shaped just right to do this. Now have the children name all the parts of the lamp and tell what each part is for.

LESSON 7.—Discuss the different kinds of kerosene lamps that the children have seen. Some may have the round wick lamps. These have a tube extending down through the center of the bowl so that the air passes up and supplies the inside of the wick, while the outside of the wick is supplied by air through the perforated base. Has anyone other kinds of lights than kerosene lamps? Perhaps some one in the neighborhood has a gasoline gas machine and makes his own gas lights. Some may have acetylene gas light, and some if they live near town, have electric lights. If there are any of these lights have the children tell how they work, and what kind of light they make.

LESSON 8.—Spend one lesson talking about where we obtain kerosene and gasoline. Perhaps the children have already learned something about this in their geography. They should know at least that kerosene, gasoline, paraffin and some other things are made from crude oil or petroleum and that this is found in the ground. Where are the oil wells in Illinois? (There are a number of large and very important oil wells in the south eastern part of our state.) Crude oil or petroleum is dark in color and almost as thick as molasses. It is really a mixture of a number of different liquids. To obtain these different liquids the petroleum is heated and these liquids are turned into vapor. The vapor is caught in large vessels and cooled so that it is changed back into liquid again. The lightest liquid changes to vapor first and so it is caught by itself. Gasoline is lighter than kerosene so it vaporizes and is obtained before kerosene. There is more kerosene in petroleum than any of the other products. If you have had in your school the petroleum products of the

Geographical Museum you have seen all the different things that are made from petroleum, as gasoline, kerosene, paraffin, vaseline. Most of the chewing gum is made from petroleum. Have the children name all the uses of kerosene and gasoline that they know. Which one is more dangerous to use? Can you see why gasoline is more dangerous than kerosene? It is because it changes to vapor so much more readily and at a much lower temperature. That is the reason it is never safe to keep the gasoline can in the home. The only safe thing to do is to keep it out of doors away from the house.

LESSONS 9 AND 10.—*Eyes and Light.*—Review briefly all of the senses and the sense organs. From the physiology text study the parts of the eye. Look in the mirror and find all the parts that are visible in your own eyes, or look at your neighbor's eye and find all the visible parts. What parts are especially adapted to protect the eye? How do the eyebrows help? The lashes? Tears? Lids? How does the eye move? Look at the picture of the eye. Find the muscles that are attached to the eye ball.

LESSONS 11, 12, AND 13.—*Care of the eyes.*—Discuss how important good eyesight is. How dependent we are upon our eyes for much of our work and our pleasure. Help the children to appreciate the necessity of taking care of their eyes. In the care of the eyes one of the most important things is to have the right kind of light to work and to study by. The best light is daylight but we need to know how to regulate the amount of sunlight that there is in a room. We should have plenty of light but should never work with the sunlight falling directly upon our book or desk or striking us full in the face. When you are doing close work of any kind the light should come from above and if possible from behind. Look at your windows in the schoolroom. Are the shades arranged so that you can have the top half down, or the lower half up as you choose? It is very easy to have the shades arranged in this manner. You see it will then be possible to have the lower part of the window screened and allow the light to come in from the upper part when it is best to have it come from that direction. When you use a lamp never sit with the lamp facing you, but if possible sit so that the light will come from behind and over your left shoulder. Hold your paper so there will not be a reflected glare. How many of you have shades on your lamps at home? No lamp without a shade should be used for reading or for any other purpose except to light up a room.

To use the eyes continuously without rest for an hour or two is never a good thing to do. If you must work for this length of time at close work, rest the eyes for a few moments occasionally. You may do this by closing them a short time or by looking from your work and out of the window or by rising and taking a brief time for exercising the whole body.

The teacher should make a careful test of the pupils' eyes, to determine whether any are near sighted or far sighted. A card for testing the eyes may be obtained from an optician. The teacher should see to it that the near sighted pupils have seats near the blackboard, maps, and other things that require close looking. Of course the best plan when you suspect your eyes are not right is to see a good occulist. If you cannot see the words in your reader clearly then there is something wrong and steps should be taken to rectify it. There are certain things that you need to think about that need to be avoided. Among others are reading when lying down, continuing to read and study when the eyes begin to smart, or reading in a moving train or a swing. Many children injure their eyes permanently in this way.

Are there any diseases of the eyes? Perhaps some of the children may have some diseases that are prevalent in the neighborhood. Many of the eye diseases are contagious. They are caused by disease germs. These germs are carried from one person to another. Can you name some of the ways by which the germs can be carried. If some one has sore eyes and rubs his eyes with hand and then touches a book or desk, how may some other child get these germs into his eyes? Do you know of any schools where the children all wipe on the same towel? Do you think there is any danger of spreading eye disease in this way?

Make the children feel that they can do much toward taking care of their own eyes.

LESSONS 14-16.—In the fifth year the children made a study of food and the digestive system. It will be worth while to spend one or two lessons reviewing the chief points of the work, especially why food is necessary. How the food is prepared

to enter the blood, and how to take care of our food. In the same way review the work of respiration. What are the chief organs of respiration? Movements of respiration. Importance of good air.

FEBRUARY

OUTLINE FOR FEBRUARY.—*Special study of circulation. Blood. Necessity of circulation. Channels of circulation. Heart; arteries; veins, capillaries. Demonstration of beef or pig heart. Experiments showing pulse rate, flow of blood in veins and capillaries. Diseases that enter the body through the blood. Effect of alcohol and tobacco upon circulation.*

Skin, structure. Perspiration; regulation of the body temperature.

LESSONS 1 AND 2.—*Blood.* What is the chief function of the blood. The children should think of the blood as the carrier of everything that needs to be moved from one part of the body to another. Name things that the blood carries; digested food, oxygen from the air, and waste products. How does the blood do its work as a carrier? What keeps it moving around through the body?

Heart.—Study the heart and the work it does from your physiology. Place your hand on your left side and feel your heart as it beats. That is, as it pumps the blood all over the body. If possible obtain a heart either of a beef or a pig. Study the parts, comparing with pictures in the physiology.

LESSON 3.—How does the blood get from the heart to all parts of the body? Study the arteries in your book. Find the big arteries extending from the heart. Place the tips of the fingers of your right hand on the wrist of your left arm just below thumb and feel the beating that we call the pulse. What is the pulse? It is the movement of the walls of a large artery as the heart pumps blood through it. Count the number of times it beats during one minute.

LESSON 4.—*The veins.* Look on the back of your hands for blood tubes that lie near the surface. What are these? Study about the veins in the physiology. Press with your finger on one of the large veins and watch to see how full the veins of your hand become further up toward the fingers. That is because you have stopped the flow of the blood up your arm.

LESSON 5.—*Capillaries.*—Study about the capillaries in your physiology finding out just what they are like and where situated. Press hard on the back of your hand. How does the spot look the moment you take your finger away? Why does it look white? It is because you have, for the moment, pressed the blood out of the capillaries. This gives you some idea of the great number of these tiny tubes that ramify through all the tissues of your body. Can you prick your finger or hand anywhere with the finest needle you have without breaking the walls of some of the capillaries?

LESSON 6.—Study the composition of the blood in your physiology, until you have the proper notion of all of its parts, serum, red corpuscles, and white corpuscles. In connection with this study impress upon the children that the blood is made up largely of digested food and oxygen. Good blood, then, means that you eat the right kind of food and breathe plenty of fresh air. When the blood is in good condition it means, too that it will be more likely to destroy the poisons that come from disease germs that get into the blood. Good blood means something else, too. It means that we shall be in the best condition to do our best work with our hands and with our minds.

What are some of the things that make the blood flow faster? Feel the difference in the beating of your heart when you are sitting still and after you have exercised in some way for a few minutes. One of the good results of exercise is to cause the blood to flow more rapidly through the body. Do you think there may be danger of exercising too vigorously? There is some danger. Moderate exercise is good for us but we may permanently injure the heart by over exercising. Running for too long a time, racing with a bicycle for a long period, jumping rope too long all may injure the heart.

LESSON 7.—Discuss how to keep the blood in good condition and the heart doing its work properly. Repeat what has already been said about fresh air, wholesome food, and moderate exercise. There are some other things besides violent

exercise that we must avoid if we keep the ciculatory system in good condition. We must avoid the use of alcohol and tobacco. Study what your physiology says about this. You should realize that alcohol often causes the heart to fail to do its work properly. Alcohol also acts upon the white blood corpuscles in such a way that they cannot do their work of destroying the poisons that come from disease germs, hence one who uses alcohol to excess is more likely to take typhoid or other contagious diseases than one who does not use alcohol. Tobacco, too, has somewhat the same effect. If you really want to be strong and well the only safe plan is to leave both of these stimulants alone.

LESSON 8.—One lesson may well be given on how to stop a bleeding wound. If the physiology treats this topic have the children study it from the book. If a large vessel is cut can you tell whether it is an artery or a vein? If the blood flows in a steady stream it is coming from a vein; if it spurts, it is from an artery. In case of a cut artery tie a hard knot in a handkerchief or cord. Place this above the cut and twist it tightly. If a vein is cut press your finger below the wound and tie the handkerchief tightly in the same place.

LESSON 9.—What is lymph and where is it found in the body? Help the children to picture lymph tubes ramifying through the muscles and tissues of the body filled with a white liquid. Find the picture of the lymphatic duct in the book and study what lymph is and how it gets into the blood.

LESSON 10.—Although children at this age may not be able to understand all that occurs in the cells and tissues of the body yet they can know a few of the fundamental facts concerning the action which takes place when oxygen and food meet in the cells of the tissues of the body. This meeting of the oxygen and digested food results in two things; heat of the body is produced, and by this union we are given energy or power to do our work. Summarize all the different things that the circulatory system does.

LESSON 11.—*Skin.*—Discuss briefly the use of the skin as a protection of the body. Study the structure of the skin as treated in the physiology. If you have a lens look on the back of your hand to find the scaly outside layer of cells. Notice the effect of cold and heat on the amount of blood at the surface of the body. Study the sweat glands; where situated; structure of oil glands.

LESSONS 12 AND 13.—What are the functions of the skin? Besides acting as a covering for the body the skin is the chief heat regulator of the body. Do you know what the temperature of a healthy person is? (It is a little over 98 degrees Fahrenheit. Winter and summer it is the same.) How can it remain the same no matter how hot the weather is? It is because the skin regulates the heat. How does it do this? One way is that the blood comes to the surface and is cooled. When we are hot there is more blood at the surface than when we are cool. In this way, then, the body is cooled to a certain extent, but the most important method of regulating the heat is by means of the perspiration. To understand how it does this we shall perform two or three simple experiments.

Fill a pan or cup exactly half full of water and set it in the warmest place in the room. Next day measure the water carefully. Is there as much water as there was the day before? What has become of it? We say it has evaporated, which means that the water has changed into an invisible gas or vapor and has gone off into the air. The same thing happens when you boil water, with one difference, the evaporation goes on more quickly when the water is boiling. Rub a little water with your finger on the back of your hand. Hold the hand up in the air waving it gently. How does the wet spot feel? Why does it feel cool? What did the water do as you held it in the air? (The water evaporated.) If you have a thermometer in the school dip the bulb into the water and hold it in the air waving it gently back and forth until the water has evaporated. Does the mercury rise or fall? From all these experiments what do you conclude as to the effect of evaporation of liquids on surrounding bodies? (It cools the bodies because heat is used in changing water into vapor.) Why does scrubbing porches on a hot summer day make the air around the house seem cool? (For the same reason the water in evaporating uses up the heat of the porch and really for a short time cools the air.) Now think what takes place when perspiration comes to the surface of our bodies. As it evaporates it uses up some of the heat of our bodies as it changes into vapor. The warmer you are, and the more you perspire

the more heat is used in evaporating the perspiration, so your temperature is kept about the same all the time.

LESSONS 15 AND 16.—*Care of the skin.*—Think of all the reasons why bathing is necessary. (Dust settles upon the body. As the perspiration evaporates particles of waste are left on the skin.) (We sometimes hear the skin called the third lung because some oxygen enters our bodies thru the pores and some waste is given off.) Can the skin do its work if not kept clean? Another reason for bathing is that it improves our appearance. Clean fresh looking faces, and clean, smooth hands are more attractive than dirty, rough ones. Discuss the best time to bathe. (In the evening just before going to bed is a good time to take a hot bath. You should take a bath of this sort once or twice every week. Can you see any reason why you should bathe oftener in summer than in winter? Some people find that a cold bath if taken in the morning is invigorating. After taking a cold bath one should rub vigorously with a towel until one feels all aglow. If it is not possible to take a cold bath in the morning, form the habit of sprinkling the throat and chest with cold water and rubbing them vigorously. You will find this a great help to prevent your taking cold.

Are there any diseases that enter the body through the skin? Review the mosquito study in the fall of the fifth year. There are certain diseases of the skin as well as of the eyes that are contagious because by disease germs. We should avoid wiping upon public towels. Some people will realize how worth while it is for every person to have his own towel.

Study from the physiology the structure of the hair and nails as modified portions of the skin. Study how to care for the nails and hair. This is a good time, also to talk about the uses of clothing. If the body generates its own heat, then what is the purpose of clothing? It is to keep the heat of the body from passing out into the air. Some kinds of cloth keep the heat in better than other kinds so we wear different materials in winter from those that we wear in summer. Warm clothing should be worn in winter but it should not be too heavy. Overcoats and wraps should not be kept on in the house because we shall get too warm and are likely to be chilled when we go out of doors. Wet clothing should not be kept on and allowed to dry on the body. Can you tell why it will chill the body? Think about the experiments in Lesson 12. The water in evaporating from the clothing uses up the heat of the body. The same rule should be observed with regard to wet feet.

LESSON 17.—If time permits make a brief study in two lessons of the brain and nervous system. The chief thing for the children to keep in mind is that the brain and nerves control all the acts of the body. They are the rulers of the body. We must care, then, for the nervous system by taking proper rest and sleep and by avoiding the use of any stimulants that act upon the nerves. It is the nervous system often more than any other part of the body that is affected by alcohol and other stimulants.

MARCH

OUTLINE FOR MARCH.—*Forestry. Identify as many trees in the neighborhood as possible. Collect twigs, study character of buds, bark, leaf scar, etc. Trees of Illinois. If possible visit a grove of native trees. How does the soil and surface differ from a prairie region? Are the trees of the district native or transplanted? Who planted them? Destruction of forests; methods of conservation; government reserves; special study of catalpa; branding buds, pods, seeds, value for posts. Plant seeds at home and school.*

Make plans for Arbor Day; how trees should be planted and cared for.

Garden. Potato. Study of tubers, bud, stem, and starch. Methods of cutting, planting. Experiments in planting large and small piece buds and stem ends. Treatment for scab. Encourage each child to plant some potatoes for display next fall.

NOTE.—There is perhaps no better place than the sixth grade to intensify tree study. Up to this time the children have been observing trees and becoming acquainted with their characteristics and uses. Now is a good time to organize this knowledge more fully and to broaden the work until it includes something of elementary forestry. If the children, however, have had little opportunity to

study individual trees of the district it may be worth while giving the time to the study as suggested for the fourth year.

LESSON 1. TREES AND FORESTRY.—Have the children make a list of all the trees they know when the leaves are on; when the leaves are off. What trees have already begun to open their flower buds? (Elm and soft maples blossom in March.) Start a simple tree calendar.

Name	Time of flowering	Leaves begin to open	Leaves full grown	Fruit and seed ripe
Soft Maple	March 15	April 20	May 8	May 20

LESSON 2.—Bring into class for this study twigs of trees; cottonwood, elm, oak, etc. Look at the twig and name all the things that you see. You should find buds, leaf scars showing where the old leaves were fastened last year, and ring scars that mark the place where the new twigs begin to grow each year. These scars will enable you to identify each year's growth. How many years' growth does your twig represent? You should find also on the bark small spots or pores called lenticels. How are the buds related to the leaf scars. Are they above or below the scars? Are the buds opposite or alternate in arrangement? Are there any buds at the end of the twigs? Are the end or terminal buds the same size and shape as the side or lateral buds? Draw a twig showing everything you see and label neatly.

LESSON 3.—Make a comparative study of the twigs of two or three other trees in the district. Note size, shape, color, and arrangement of buds, etc. Do you find more trees with opposite or with alternate buds? Compare different trees as to the growth that they make in one season. Measure the length of one year old twigs and note the difference of growth rate between "hard" and "soft" woods. Study also the characteristics of the entire tree. This may be done outside of school hours and reported. Note the method of branching of each tree. Color of bark. Is the bark smooth or rough? Furrowed or scaly? Do the scales form any distinct patterns? Does the surface and color of the trunk differ from that of the branches and twigs? Are last year's seeds still clinging to any of the trees? If so, collect and preserve these.

LESSONS 4 AND 5.—Study of the wood. Get some one in the neighborhood at the time the trees are being pruned to make a few cross sections of the large branches of as many trees as possible. If someone cuts down a tree try to get a cross section of the trunk. Start the children in making a collection of specimens of wood of the different trees. Each section should be made straight across and should be two or three inches thick. Very small cross sections will serve for this lesson if large ones cannot be obtained. A few longitudinal sections may be of service. These may be made by splitting some of the cross sections through the middle.

Look at the cross section of wood. How many distinct structures can you see? If it is a large section you will find hard wood at the center known as the heart wood, softer wood outside of this which is called sap wood, and on the outside of this is the bark. Do these different parts show any difference in color? Do the colors differ in different kinds of trees? Can you see any rays extending outward from the center of the section? These are called pith rays. How many rings are there in your specimen? What do the rings indicate? Each ring usually indicates a year's growth. Make drawings of cross sections showing all of the parts.

LESSON 6.—Secure a few fresh twigs from a willow, maple, or cottonwood. How does the bark on the young stem differ from that on the trunk or older branches? Why do you suppose the outside became so rough on the older stem? Look at the branches of various ages to see if you can solve this problem for yourself. (The inside layers of bark and wood grow so much more rapidly than the outside layer that it is compelled to stretch. After a time it can stretch no further and so cracks and splits open forming furrows or scales.)

Peel a piece of bark from the twig. What is the color of the bark on the inside? See if you can find three layers in the bark. The thin skin on the outside is called epidermis. Just under this is a green layer and on the inside is the white layer called bast.

How does the wood look under the bast? Is it dry or wet? Rub your finger over it. How does it feel? This sticky, sappy layer between the wood and the bark is called the cambium. It is very important, for this is where the new cells of wood and bark are formed, making a new growth of wood and bark.

Cut a cross section of this young stem. Does it resemble the section of the old stem? The soft part you find in the center is pith. Can you see any rays going out from this? After a stem is a few years old the pith disappears.

LESSON 7.—Work and growth of trees. If trees grow they must have food. If you bore a small hole in a maple tree in the early spring, or break the end from a branch, what runs out? Did you ever taste this sap? Why does it taste sweet? It has sugar in it. How is maple syrup made? Perhaps some of the children have visited a sugar camp and can tell how the trees are tapped, how the sap is collected and then boiled down into syrup or sugar.

Where do the trees get this sap? It was stored in the roots during the long winter, but the leaves manufactured it the summer before, so one may think of the leaves of the trees as factories that make the food for the whole tree. The roots take from the soil water and some minerals in solution. The water travels upward through the stem to the leaves. The leaves take a gas called carbon dioxide from the air and all day long they are using water and this carbon dioxide in the manufacture of food for the tree. Some of the food is used at once in the growth of the tree, the leaves, and flowers, but a great deal of it is stored up in the stem and the root and used when the tree begins its growth in the spring. Has a tree enough food stored up in its stem to start the young leaves growing in the springtime? You may test this by breaking off a few twigs, putting them into water, and keeping them in the light. Watch the opening of the buds and see how large the leaves succeed in growing in the school room.

LESSON 8.—A simple experiment may be tried to show in what part of a stem water travels upward. Put a teaspoonful of red ink into a tumbler half full of water. Get some fresh twigs of maples or willow or some other tree and place them in the cold water. Let them stand until the next day. Now make some cross sections with a sharp knife and notice in what part of the twig the ink traveled upward. You will find that it is in the wood. In the tree trunk only the newest layers of sap wood carry the water upward. You will be interested to know that the bast, the inner layer of bark, carries the food downward from the leaves to the stems and the roots.

LESSON 9.—If you live in a wooded region have the children identify as many of the trees as possible. You may have to wait until the leaves are out before you can be sure of all the trees. You should find in our native Illinois groves oaks of several kinds; white, red, black and burr oak are most common. You are not likely to find all of these in the same grove. Some other common Illinois trees are the buckeye, walnuts, sugar maple, sycamore, ash, iron-wood, elms, hickory, mulberry. Which of the trees have the largest trunks? Which are tallest? Are there any young trees growing up among the old ones? What kind is most numerous? Are there many decaying logs on the ground? Have many dead branches dropped from the trees? Is there much underbrush? What use if any, is made of woods where you live? Do stock run in them? Do cattle and sheep injure the young trees? Are any of the trees cut down each year? What are they used for?

If you live in a prairie region have the children tell how far they would have to go to get to the woods. There are not many sections in Illinois that are more than ten miles from a wooded region. Most districts are nearer. Have the children ever gone to the woods? Do they know any of the native trees? They should know at least what some of our common trees are. A collection of twigs, leaves, and fruit is of value for tree study.

Where do we find trees in the prairie region? Try to have the children picture a time when there were no trees here. Nothing but the tall, prairie grass and prairie flowers. How have the trees come into this region? Find out, if you can, something of the history of the trees in the district. Who set them out?

Which are the oldest trees? Has any one set out trees in recent years? Do you find any trees in the prairie region that were not set out by man? Sometimes you will find along the streams a number of willows and occasionally in a field a big cottonwood that has been there for years. Can you think how these trees were planted? What kind of seeds have the willow and cottonwood? They have tiny seeds attached to bits of cotton that may blow miles and miles on a windy day. There is little doubt that these trees plant themselves.

LESSON 10.—Discuss the value of trees. Make a list of the industries that depend upon forests. (Lumbering, furniture making, ship building, the making of cars, wood pulp, paper making, turpentine, tar, etc.) Where are the forests that supply these great demands? Where are most of the trees that are used for lumbering? What kind of trees are used largely for lumber? Are they conifers or broad leaved trees? Are there as many trees from which to make lumber as there were years ago? What are some of the things that are helping to destroy our forests? Have you heard of forest fires? How do they get started? Sometimes they are started by a spark from engines, but more often by carelessness on the part of campers or other people. Hundreds of acres of excellent timber are burned every year. Do you know what our government is doing to prevent the destruction of our forests? Make plans for an Arbor Day program, using some of the compositions written by the children in these studies.

LESSON 11. THE POTATO.—For the purpose of arousing interest, the lessons on the potato may begin with an informal discussion of the importance of the potato crop in the district. Do all families in the neighborhood raise potatoes? Do they raise them as a garden or as a field crop? Are there more than enough produced to supply the home demands? If some are marketed are they sold, in the fall or stored until spring? How are they stored for the winter? Illinois ranks seventh among the potato growing states of the Union. In 1906 the value of the potato crop in this state was a little over nine millions of dollars.

Ask each pupil to bring a potato to school, if possible, the kind that is to be planted at home in the spring.

If the teacher can procure types of two or three varieties of potatoes she will find them of value in presenting this work.

LESSON 12.—With the potatoes before the children raise the question what is this that we call a "seed potato?" Is it really a seed? (Draw upon the experience and observation of the children as to what a seed is. Name some seeds that we use for the purpose of starting new plants, such as peas, beans and radishes.) Where did these grow upon the plants, and what preceded them in every case? It will not be difficult to have the children see that whenever true seeds are produced they are always preceded by flowers. They will readily see, also, that the potato is not a seed. What, then, is it?

Examine the potato. What do you find scattered over the surface? Do any of the eyes show signs of growth? What is growing from them? The eyes are buds. Where are the buds most numerous? Are they all the same size? (The end of the potato on which the buds are so numerous is called the seed or bud end of the potato.) Look at the opposite end. What do you find? If you do not find a small stem you will see the scar where the stem has been fastened. This end of the potato is known as the stem end.

Now hold the potato in your hand and think what it would resemble if you could stretch it out many times its length and having its width reduced accordingly. It would look like a stem with buds on it. That is just what it is, a thick, fleshy stem, and since it grows in the ground we call it an underground stem. This particular form of underground stem is called a tuber. So you see we use tubers instead of seeds to propagate new potato plants.

LESSON 13.—Cut the potato in two through one of the eyes. How does the cut surface feel when you rub your finger over it? How many different structures do you see in this surface? (You will find the peeling which corresponds to the outside layer of bark on a tree stem, a dark line about a quarter of an inch from the outside, and the mass of white material in the center. The dark line corresponds to the woody layer of a tree stem and the white mass to the pith. Does the woody line extend up into the bud?

LESSON 14.—Scrape the white portion from two or three potatoes. Put the scrapings into a cup or glass full of water. Stir thoroughly. Allow this to stand twenty-four hours then pour off the liquid and bits of potato. What is left in the bottom? If you pour hot water on this starch it will thicken just as laundry starch does.

There is another way to prove that this is starch. Dilute a little of the tincture of iodine with about twice the amount of water. Place a few drops of this upon the starch. What change of color takes place? (Iodine acts chemically upon the starch changing the color to blue. The more starch there is in any substance the darker blue it becomes.)

What is the use of the starch in the potato? (This may be left as a problem to solve later in the year.)

Fill a box or tin pail two-thirds full of sand and plant two tubers in it. Fill another box with soil and plant two tubers. Keep both well watered. When the plants are about four inches high dig up one from each box and note whether or not the tuber shows that some of the starch has been used. Is there any difference between the one grown in sand and the one in soil? Leave the other two plants until the last week of the spring term then examine to see if they have used up any more of the stored food. How do you account for the difference between the one grown in sand and the one in soil?

This will be a good time to observe just how the shoot grows from the bud, and where the roots are produced. If the plants have made a vigorous growth you may be able at this time to find the small underground stems with the tiny tubers beginning to develop at the outer ends.

LESSON 15. CUTTING THE POTATOES.—Are whole or only portions of the tubers used for seed? Discuss the various methods used at home. Tell the children that many experiments have been made by experts to try to determine the best way to cut tubers. Most of the experiments show that a chunky, compact piece with at least two eyes usually gives the best results. Some very interesting experiments may be worked out by the children in this connection.

LESSONS 16 AND 17.—PLANTING.—Discusss with the children the time potatoes are planted at their homes. The time of planting must necessarily vary with locality. A good rule to follow is to plant the early crop as soon as the soil may be worked in the spring. Many plant the main crop very early also. Potatoes require a vast amount of moisture so they should be planted in time to catch some of the spring rains.

The preparation of the seed bed is important. How many of the children know whether or not the potato plots are plowed in the fall, or spring on their home grounds? Can you think of any good reason for fall plowing? Does any one in the neighborhood sow rye in the potato plot in the fall and plow it under in the spring? What is the value of this? (It does two things that are good for the potatoes. The decaying rye helps to enrich the soil, and at the same time it helps to make the soil loose and mellow.) Can you think why these are desirable characteristics of soil in which potatoes are to be grown? (As the tubers grow they must push the soil out of their way; you can easily see how hard, compact soil may dwarf their growth.) Who in the neighborhood use fertilizers on the soil? It is not a good thing to put barn manure on the ground just before planting. It is likely to increase the growth of the potato scab. You will see why when you take up the study of fungi. The manure should be applied and plowed under in the fall. Some potato growers think a better plan is to put the manure on one year, grow corn or some other crop, and follow with the potato crop the second year.

It is not a good plan to plant potatoes on the same ground year after year. We shall not try to explain here the reasons why. We shall do that when we study how to maintain the fertility of the soil. It is enough to know that a rotation should be practiced in growing potatoes as well as other crops.

How far apart shall we plant the potatoes? Here is another opportunity to draw upon the home experience of the children. Why may potatoes in the garden that are to be tended by hand be planted closer together than those in the fields that are to be cultivated with horse cultivators?

In the garden the rows may be as close as two and one-half feet; in the field they should be three feet apart. The pieces should be placed from twelve to fifteen inches apart. One compact piece in a place is better than two small ones.

How deep shall we plant the potatoes? There are some good reasons why we should not plant too near the surface of the ground. We shall see why when we check up some of our home and vacation experiments. In compact, heavy soil it may be necessary to plant not more than three inches deep. However, in mellow, loose soil the pieces should be four or five inches below the level surface of the plot.

Discuss the method of planting potatoes practiced in the neighborhood. How are the furrows made? How are the pieces dropped? How covered? In some states where potatoes constitute the chief crop, planters are used which open the furrows, drop the tubers, and cover them at the same time.

LESSON 18. METHODS OF CULTIVATION.—What machinery is used in cultivating the crop? Let the children report on this and on the number of times the crop is cultivated. The harrow is an important implement in cultivating potatoes. The soil should be harrowed once or twice before the plants appear above the ground. After the plants are up a hand hoe or corn cultivator should be used, the oftener the better. Care must be taken not to cultivate too deeply, just a few inches of the upper soil should be stirred. Can you see why? (There is danger of injuring the roots and the small underground stems.) Which is better, to keep the potato plot as level as possible or ridge up the rows?

Plan for a potato contest this year. Each pupil should plant a small plot of at least forty hills, sixty or eighty would be better, or an eighth or a fourth of an acre. The plots should not be so large that the amount of work required to keep them in good condition will be discouraging. A number of interesting experiments may be tried. Some of these experiments may possibly be worked out on the family plots where the labor may be shared with the father and his help. For the sixth grade, experiments one, two, and four are excellent. If prizes are to be awarded they may be of three kinds. First, for the best yield per acre. Second, for the smoothest, largest potatoes. Third, for the best results from the experiments attempted.

The pupils should keep a simple careful record of their work and observations. This will be of the greatest value when the work is reported in the fall.

The record should include: exact amount of potatoes planted; date of planting; how long after planting before plants appear above the ground; date when potatoes are large enough to use; number of days from time of planting until potatoes are fully mature, the vines dead or dying; method of cultivation; special treatment of special experiments; date of flowering. A brief study of the flower may be made. Note the color and position on the stem. Do different varieties differ in color of flowers? Examine one flower. Do you know of the flowers that are similar in shape and structure? Compare with tomato and common night-shade. (The potato and tomato both belong to the night-shade family.)

What insects or other foes have bothered your plants? What methods have you employed to combat them?

SUGGESTED EXPERIMENTS: 1. Does the size of the piece of potato planted have any effect upon the yield? Plant one row each of whole tubers, halves, quarters, and very small pieces with but one eye. Give all exactly the same cultivation. 2. Will plants grown from small potatoes yield as well as those grown from larger ones? Plant two rows of very small tubers and two using large tubers of the same variety. 3. Which will give better results shallow or deep planting? Plant one row two or three inches deep, another five or six inches. 4. Which will yield the best the bud or stem end of the potato? Cut the potatoes in two through the middle. Plant the bud ends in one row, the stem ends in another.

5. How may potato scab be prevented? Treat enough tubers with formalin solution to plant two or three rows. Formalin may be obtained at any drug store. Put a tablespoonful into a gallon of water. Place the potatoes in the solution and allow them to remain two hours. Remove, let them stand till they are dry, then cut and plant. Scab is a fungous disease that makes potatoes rough and dwarfs their growth. The fungous starts from tiny cells or spores that stay on the seed potatoes. Formalin kills the spores. When potatoes are raised on the same ground year after year the spores sometimes live over winter in the soil and are all ready to attack the young potatoes when they begin to grow. If there were no other, this is a good reason for practicing rotation of crops. (Suggested reading, Mann's Beginnings in Agriculture, pp. 171-176.)

APRIL AND MAY

OUTLINE FOR APRIL AND MAY.—*Fruit Trees, identify the apple, cherry, peach, plum, pear. Study one as a type. Compare as to size, bark, shape, leaves, flowers. Special study of a flower. Note parts with function. Orchard methods, pruning, spraying, etc. Note effects of late frosts upon flowers.*

Garden. Make plans for planting home gardens and, if practicable, a school garden. Plant some biennials, as parsnips, salsify, beets; some annuals, as beans, peas, and melons. Some flowering plants; select from seed catalogues.

Birds as tree protectors. Special study of warblers during migration in early May; migration studies; classify birds on basis of sojourn here—permanent residents, summer residents, winter residents, migrants; service rendered by insectivorous migrants.

NOTE.—In preparation for the garden work later in the month plant in shallow pans or boxes some squash, pumpkin, cucumber, and melon seed.

LESSON 1. FRUIT-TREE STUDIES.—Make a list of the fruit trees in the district. Choose one for special study. If the cherry is abundant this is a good one to study as a type. Tell the children to look at their cherry trees at home and note the following: How tall are the trees? What is the color of the bark, of the trunk, or the twigs? Is the bark smooth or rough? On what part of the trees is it most shiny? If you try to peel off a little of the bark which way does it peel, up or down or around the tree? How thick is the trunk of the tree? How old is the tree that you are studying? How does it branch? Do the limbs separate into two or three branches or does the main trunk extend to the top of the tree?

LESSON 2.—For this lesson have some twigs in class with the flowers on. See if you can find on these twigs all of the things that you found on the twigs of the shade tree studied in March. (See Lesson 2, March.)

LESSON 3.—Where are the flowers situated on the cherry twigs? Are they single or in clusters? Are there any leaves upon any of the twigs? Are there separate buds for the flowers and leaves? Do you find both flowers and leaves in all of the buds? Look carefully at one flower. What do you find at the top of the slender flower stem? This green cup with the leaf-like bodies turned backward is the calyx. Each of the green bodies is a sepal. How many sepals are there in the calyx? The white part of the flower is the corolla, and each white leaf-like portion is a petal. How many petals has the flower? What do you find inside the flower? The small bodies with the little knobs on the end are stamens. Are there many or few of these? To what are they fastened? Look in the center of the flower for a body different from the stamens. This is the pistil. Look at the very lowest part of the pistil for a round body called the ovary. The slender stem-like part above this is the style, and the little disc-like portion spread out at the top of the style is the stigma.

LESSON 4.—What is the function of the flower? It produces fruit. It takes both the stamens and the pistil to produce fruit. In the little knobs on the stamen you will find a powder; it is pollen. The pollen must be placed upon the stigma of the pistil if any cherries are produced. What part of the flower will grow into the cherry? Leave this as a problem to be solved later by observation. Watch closely to see what parts of the flower wither and fall off, and what parts remain.

LESSONS 5 AND 6.—Make a comparative study of the flowers of other fruit trees, especially the apple, plum, and pear. Note the points of resemblances and differences. Compare the flowers as to color, number of stamens, and number of pistils. Compare the trees noting which have the smoothest bark, which grow tallest, which spread out most. Find out, if you can, which of the trees on your home grounds are oldest, and which of them blossom first in the spring. Are all of the stamens attached to the calyx? The flowers are enough alike to cause botanists to place all of these trees into one great family; the rose family. If you have any wild roses in the neighborhood procure one of the flowers and compare it with these tree blossoms.

LESSON 7.—Note carefully any effect of late frosts on the fruit. What part is blighted? To determine this examine the pistil. If it is green and fresh then the fruit is all right, but if it is blackened the fruit is killed. Watch to see if any

of the blossoms fall off even though they are not injured by frost. Is it a good thing to have some of the flowers fail to produce fruit? Think what would happen if every single flower on your apple or cherry tree should produce an apple or a cherry. The trees would not be able to bear up the weight of the fruit.

LESSON 8. CARE OF FRUIT TREES.—Let the children discuss different ways in which their fruit trees are cared for. Have them observe how far apart the trees are planted in the orchard. Which are planted closer together, apple or peach trees? Is the soil cultivated in order to raise other crops between the rows of trees? Many fruit growers believe in cultivating the soil, especially when the trees are young. Sometimes other crops, vegetables and even farm crops, are raised between the rows. Apple and pears are longest lived of our fruit trees. Peaches are the shortest lived.

LESSON 9. PRUNING.—Discuss the care of trees with reference to pruning. When are the trees pruned? Who does the work? Why is it necessary? Young trees, especially apple, should be pruned to compel the tree to form a well-shaped head. A fruit grower wishes to have the tree not only well formed, but with just enough branches to permit free circulation of air and the right amount of sunlight. If the branches are too close together the fruit is likely to be small because it is too much shaded. If the branches are too sparse the extreme heat of the sun may injure the fruit and perhaps the tree.

The best time to prune is late winter or early spring. How should the branches be cut? Look at some of the trees where branches have been removed and report what you find. If the pruning has been properly done you will find that the wood has healed over and is perfectly smooth and hard. Do you find a little stub sticking out from the tree? Why is this a poor method to use in pruning? We must think back to your study of the structure of the forest trees. You remember that under the bark is the cambium layer. It is this layer that helps heal the tree where the branch is removed. It succeeds in healing the wound more rapidly when the cut is made close to the tree. When a stub is left the wound is long in healing and often germs of some tree disease will start to grow before it is entirely healed. This results in the decay of the branches and often of the entire tree because the decay works back to the main part of the tree.

LESSON 10. SPRAYING.—How many in the district spray their fruit trees? What is the purpose? To destroy fungous diseases and insects that injure the fruit or the trees themselves. Fruit growers who expect to market their fruits are careful to use the spray. Farmers, however, who raise only a little fruit for home consumption, do not, as a rule take much care of their trees. It pays, however, to use a small hand spray for the home fruit garden. The common spraying fluid used for fungous diseases is Bordeaux mixture. It is made of from three to four pounds of copper sulphate mixed with four to six pounds of lime in fifty gallons of water. If one wishes to kill insects at the same time usually one-half pound of Paris Green is added.

Can you name some insects that are injurious to fruit trees? Do you ever find worms in cherries or apples? These are the young of the codlin moth. The moth lays its eggs on the young apple just after the petals have fallen from the flower. The egg hatches and the tiny worm eats its way into the apple. If the tree is sprayed at just the right time, that is just after the petals have fallen, many of these little creatures will be killed. (Suggested reading Mann's Beginnings in Agriculture, pp. 177-185.)

THE GARDEN. LESSONS 11 AND 12.—Make plans for home gardens and if practicable arrange to plant flowers on the school grounds. Besides potatoes, which we discussed in the March lessons, plant a few other vegetables. This is a good time to make a special feature of the raising of melons, squashes, and cucumbers. Consult the catalogues for different varieties. Try to get each pupil to procure at least two kinds of cucumber, squash, and melon seeds.

Make a study of the squash or pumpkin seeds. Soak some in warm water for twenty-four hours. Remove the outside covering. Is it thick or thin? Is there another covering left on the seed? Is the kernel in one or two parts? Each of these parts is a cotyledon or seed-leaf. Find the pointed body at the lower end of the cotyledons. Are the cotyledons fastened together at this point?

Remove from the soil some of the young plants that you started a week or two

before. Did the seed coats come up as the plant grew? By looking closely you will see that the root and most of the stem grew from the pointed body. What have the cotyledons become? (Those round broad leaves of the plant.) Are these leaves the same shape as the leaves of old squash plants? Do they remain on the plant? Leave this as a problem to be solved later as the plants continue to grow and develop.

LESSON 13.—Compare with the squash the little plants that you have grown from the cucumber and melon seeds. Are they similar? Do they look as if they might belong to the same family? These plants are all relatives. Do you know anything about the habits of growth of these plants? Recall what you have seen in the gardens. Are the stems erect or prostrate? Are the leaves large or small? Did you ever pull a leaf and note the hollow leaf stem? Did you ever look closely at the flowers? When is the fruit ready for use?

LESSON 14.—What is the best time to plant cucumbers, squashes, and melons? Why can we not plant these early as we do potatoes or peas? These plants were formerly raised in warm climates so they are not able to stand even a slight frost. We most always wait until all danger of frost is past before we plant any of these seeds. In preparing the soil begin two or three weeks before planting time. Work it up until it is loose and fine. If it has not had some manure or other fertilizer plowed into it in the fall or early spring it will be worth while to fork into it now some well rotted manure. Some gardeners make mounds or ridges a few inches above the level of the garden in which they plant the seeds. Others, if the drainage is good, think it best to plant seeds on a level with the garden. It might be interesting to try both methods. The plants should be from four to six inches apart. They should be cultivated carefully at first. After they are well started they usually cover the ground sufficiently to keep down the weeds.

LESSON 15.—Spend one lesson discussing the value of the melon family. How many in the neighborhood raise squashes and cucumbers for table use, for the making of pies, etc? Who raise cucumbers for pickling and slicing? Pumpkins for feeding cattle? Water melons and musk melons for home use? Are any of these raised for marketing purposes? Let the children gain a definite picture of what these plants mean to many people in the making of a living. Picture the great truck gardens near the large cities where melons are raised for the market, where squashes or pumpkins are raised for canning, and cucumbers for the great pickle factories.

FLOWERING PLANTS. LESSON 16.—Plan to raise flowering plants. Spend some time looking over the seed catalogues to get acquainted with different flowering plants. Make definite plans for a flower contest in the fall. Do not attempt to raise too many. Three or four different kinds are better than a greater number. Discuss some of the reasons why we wish to learn how to raise flowers. Two reasons at least should be given; that we may make the home and its surroundings more attractive, and that we may have flowers to give to our friends. If we are to realize the first then we must learn to make the flower beds attractive. We must plant flowers together whose colors will harmonize and we must know which are shortest and which tallest among the flowers which we plant. A pretty group is the following:

California poppy for the low flowers. These grow a little over a foot high, and have a light yellow flower. They blossom until late in September if the flowers are kept gathered. Gaillardia grows about two feet high and has a rich orange and brown flower. These should be planted about ten inches apart. Still taller and back of this princes' feather may be planted and still back of this cosmos. This makes an excellent background for the entire group and is beautiful even if the flowers are late in coming. Another pretty bed may be made up of a sweet alyssum border entirely around the bed with blue larkspur or corn flower in the middle. Another group is candytuft and calliopsis.

Impress the necessity of preparing the soil properly before planting their seeds and of planting the seeds near enough to the surface. A good rule to follow is to plant each seed as deep as four times its own diameter. To cultivate the plants keep the soil stirred and fine on top even if there are no weeds to pull up.

LESSON 17. BIRDS.—Can you name some birds that are specially useful in protecting our trees from insects? Review the woodpeckers, the hairy and downy, that kill so many borers in our fruit trees, and the chickadee that feeds all winter upon insect eggs around the buds and twigs of the trees. Other birds that are useful to the trees are nuthatches and brown creepers that creep over the trunk eating

eggs and tiny insects that are stowed away in the crevices of the bark. It will add much to this lesson to have pictures of these various tree protectors.

LESSON 18.—Most of these little birds that we have been talking about are with us during the winter. Can you think of any other birds that stay with us all winter? (Among these are the jay, crow, kinglets, tree sparrow, horned lark and occasionally a meadow lark. Are any of these with us also during the summer time? A number of these stay with us all the year around and so we call these permanent residents. Can you name four birds that are permanent residents? (Jay, crow, chickadee, downy woodpecker.)

Some of the little birds that are with us during the winter time are winter visitors. They come to us from the far north to spend the winter and when spring arrives they go back north to spend the summer and rear their young. Among these are the kinglet, tree sparrow and brown creeper. These birds are called winter residents.

Can you name some birds that stay with us only during the summer? These we call summer residents. They are birds that come to us in the spring, build their nests and rear their young, and then in the fall go south to spend the winter. The greatest number of our birds belong to this group. They are robins, blue birds, orioles, thrushes, fly catchers, and others.

LESSON 19.—There is another class of birds that we call migrants. They come to us for a short time in the spring and again in the fall. Among them are some of our very best tree protectors. They stop with us a few days or perhaps a week as they travel from the south where they spend the winter up to the northern part of the United States and Canada where they spend the summer. Watch carefully among the trees the first, second, and third weeks of May for small birds about the size of wrens. You will find them flitting about among the twigs, sometimes singing songs, sometimes merely chirping, always looking among the young leaves and twigs for insects. These little birds are wood warblers. Some of them are brightly colored with yellow, bright orange, blue and dark green. There are about thirty different kinds that visit us every spring and fall. Two of them, however, stay with us and build their nests. These are the summer yellow bird and the Maryland yellow throat. The yellow bird is the most yellow of all the birds we have. It has a few little streaks of brown on the breast and the wings and tail are duller in color than the rest of the body. The Maryland yellow throats we may find around the streams and hedges where they build their nests. Their throats are bright yellow and the sides of their heads are black. If you once see one of these little birds you will never forget it.

VACATION NOTES.—Besides the plan suggested for vacation on the potato study, encourage the children to make observations and keep records of the fruit trees. Watch carefully to see if you can find out just what part of each flower produces the fruit that we eat. What part makes the apple, pear, cherry?

Make observations of the squash, pumpkin, melons, and cucumber flowers. Note their shape. See if you can find all the parts that we found in the fruit tree flowers. Watch to see what part of these flowers produce the fruit. When are cucumbers ready for use? Decide which kind you prefer for slicing, for pickling. Observe any insect enemies that you may find on your cucumber vines.

LESSON PLANS FOR SEVENTH YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER.—*Report of vacation activities including work done and money earned. Start calendar of farm activities for September. Continue this for each month throughout the year. Make plans for out-of-school work for partial credit. Preliminary work on wheat.*

Insects injurious to corn, to fruit trees, to clover, to garden crops. Beneficial insects; ground beetle, ladybirds, braconids and other parasites.

In the seventh and eighth grades the work may well take on a more decided agricultural trend. At the same time it should be based upon the underlying principles of science. Hence the methods employed should be similar to those used in the lower grades; that is, the work of observation and handling of objects must be continued. In no other way can the work do for the pupils all that it is capable of doing.

It is most sincerely hoped that the observation work will be carried on in these grades even if a text book in agriculture is used. A book can never take the place of actual hand to hand contact with real objects. It may be profitably used to supplement the work of observation. The directions for observation may be placed with profit in the hands of the pupils so that much of this work may be done outside of the class period. In these grades every pupil should keep a simple note book in which he records briefly, yet accurately, the various studies, experiments and observations.

Teachers who are planning to do this work in agriculture should collect material for the work during the summer months. The following is a list of material that will be found helpful:

A few heads of oats.

Some smutted oats.

Some heads of wheat.

A collection of common insects pests and beneficial insects.

A few small ears of corn gathered when the shoots first appear. These should be put up in alcohol or a four per cent solution of formalin. A mason jar carefully sealed serves admirably for this.

A few tassels from green corn carefully dried and preserved.

Some corn smut.

While most of the lessons are arranged in the order of time, the following plan is suggested in order to get all of the work started at the beginning of the term: After the first three or four lessons in which arrangements for home work, etc., are planned, a few lessons on insects should be taken up so that the pupils may begin collecting. Follow this with the first three lessons on wheat suggested in the October number. In this way the germination and purity tests will be made before wheat is planted. Then return to insect study for the rest of the month.

WORK FOR BOYS WHO ARE OUT OF SCHOOL UNTIL AFTER CORN HUSKING.—In districts where boys of the seventh and eighth grades can not enter school until after corn husking the teacher should call a meeting of these boys early in the term and give them some outline studies of insects, wheat, and corn. They will have ample opportunity to make many interesting observations in connection with their work. They should also be encouraged to keep the farm calendar and a record of the work they are doing just as the pupils in the school do.

REPORTS OF VACATION WORK. LESSON 1.—If the pupils have been carrying on experiments and observations during the summer, the first lesson should be given to reports of work done, the difficulties encountered, and the present conditions of the plants studied. It may be necessary to spend more than one lesson on these reports.

LESSON 2.—Have the pupils make plans to keep a "farm calendar" which will show the activities on the farm for the month. This should be placed in the note book and several pages reserved so that the items for the entire month will stand together. The following form is suggested:

FARM CALENDAR FOR SEPTEMBER

First week	1. Finished plowing for wheat.
Sept. 3-9th	2. Began cutting corn for silo.
	Etc.

At the end of the month spend one recitation period in comparing calendars. This will give opportunity for an interesting discussion of all the activities carried on in the district during the month.

LESSONS 3 AND 4.—It has been hoped that pupils in this year's work may have some definite tasks at home that will fit into their school course in such a way that they will receive credit in the course in agriculture for the work done at home. The practicability of this plan is yet to be tried. We hope that a few strong teachers who have the cooperation of patrons may undertake this work. Enough other work will be outlined for the months so that teachers who feel they can not do this work with profit will have plenty of other material.

In arranging this work, let each pupil name a certain home task for which he will be responsible each day. It may be milking, feeding the pigs, currying and bedding the horses, and, on the part of the girls, some household task. A record of the work should be kept on a separate page of the note book or on a sheet of paper, or card. The record should show the name of the piece of work, the time spent, and how well done. This last item should be given by the parents. A space for remarks may be left in which the pupils may record any points of interest that he discovered in connection with this special work. A visit from the teacher during the month to the home of the pupil to talk over the work that he is doing will be in incentive to do the best work.

At the end of each month use the time of one recitation for reports and discussion of the work.

INSECTS.—Insect study in the seventh and eighth grades should be linked as closely as possible with the study of plants. Insects are so intimately connected with the life and success of crops of all kinds that it is worth while for the pupils to know as much as possible of the habits and life history of these little creatures, to recognize friends and foes and to learn some of the ways of combating the pests and increasing the numbers of the beneficial insects.

The plant life of any locality should largely determine the special insects to be emphasized. In a region where corn is the chief crop, insects pests common to this plant should constitute the bulk of the work. In a fruit growing community, insects found in fruit trees and shrubs should receive most attention.

The equipment necessary for insect study is suggested under grasshopper studies in the fifth grade; since in this grade, however, a collection of insects is desirable, a cyanide jar to use in killing specimens should be added to the equipment. To make a cyanide jar, place five cents' worth of cyanide of potassium in the bottom of a wide mouthed bottle; a pint mason jar is very good for this purpose. Make a stiff paste with water and plaster of Paris; pour this over the cyanide, covering it about an inch and a half in depth. Allow the bottle to stand open about two hours, then close it up tightly, and keep closed except when putting insects in or taking them out. Write the word "Poison" on a piece of paper and paste it on the jar.

If the pupils have had no previous study of insects, the lesson should begin with some of the larger forms for the purpose of becoming acquainted with the characteristics common to all insects. A grasshopper is a good type for this study.

LESSONS 5 TO 7.—(The number of lessons given to this preliminary work will depend upon the knowledge and previous training of the pupils. In preparation for the lesson, ask the members of the closs to bring in, at least, one large grasshopper. Place the grasshopper in the cyanide jar a few hours before the time for the lesson. Let the pupils find the answers to these questions by observation.) How many body divisions can you see in a grasshopper? Look both at the upper and under surfaces. (The pupils should make out the following parts: The head, the thorax, and the abdomen. The thorax is made up of three rings, the first of which forms the cape-like part back of the head. This is called the pro-thorax. The second and third rings

are so closely united that the division line cannot be found; however, the pupils should know that the second pair of legs are attached to the second ring, and the third pair of legs to the third ring.) Study the structure of the abdomen, noting that it is made up of rings. Count the rings and decide whether they overlap from front to back or from back to front.

For the study of the head, antennæ, eyes, mouth, habits of feeding, legs, wings and life history, use the topics suggested for fifth year.

LESSON 8.—The grasshopper is an excellent example of an insect with a biting mouth. All insects have either biting mouths with strong jaws, or sucking mouths. If possible, follow the study of the grasshopper with that of an insect with a sucking mouth. The squash bug, a dark gray insect about five-eighths of an inch in length found on squash and pumpkin vines, is a good type. Also the red and black box elder bug, the stink bug, or the cicada. This cicada is often called the locust, which is familiar, because of the long drawn out song that is heard every summer in trees of various kinds.

The following outline may be used with any of the above types. Notice the general form of the body. Compare with the grasshopper and determine whether or not the same parts are present. Look at the front part of the head for the mouth. You will find a straight tube lying on the under part of the body, extending as far backward, often, as the last pair of legs. This is the sucking tube. At the lower part, the jaws are so arranged that the insect may pierce through the membrane of leaves and stems and suck the juices from the plant. Notice the wings of the insect. How are they related to each other? You will find that the ends of the outer wings overlap each other. All insects with wings of this kind and the piercing sucking mouth are true bugs.

INSECT PESTS.—Encourage the pupils to make a collection of insects pests found in the district, also a collection of beneficial insects. Corn pests that are common and that may be studied in the fall are the corn-root aphis, the corn ear worm, the white grub, the corn root worm, the cut worm.

THE CORN ROOT APHIS. LESSON 9.—It may not be possible to find the corn root aphis feeding on the roots of the corn in September; however have the children look on the roots of stunted stalks of corn. They may find a few aphids and possibly some ants that should be studied in this connection. The aphids should be studied, however, even if the corn root aphis can not be found. The pupils will find aphids or plant lice on cabbage, lettuce leaves, stems of wild lettuce, cherry, willow and plum stems, etc. They are small insects which vary much in color; some are black, some are red, some green. Have in the class some leaves or stems with aphids on them. Do all of the aphids on the plant look alike? (You will probably find on one plant several stages of the insect; some small ones without wings, some larger with pads on the back, which are the beginnings of wings, and some with quite large wings folded above the body. These look like small flies or small gnats.) What are the aphids doing? Hold the leaf or stem on a level with the eye and look closely at the head, to find the slender sucking tube, which is inserted in the leaf or stem. It is just like the sucking tube of the squash bug. What kind of food then does an aphid eat, solid or liquid? Do you think putting poison on the surface of the leaf will kill the aphids? Why? (In order to kill them, something must be used that will destroy the insects by coming into contact with their bodies, since they suck the juices from the inside, poison on the surface of the leaf will not harm them. How many legs has an aphid? Observe how the aphids hold their antennæ.

LESSON 10.—Do you find other insects on the plants with the aphids? (The pupils will probably find ants.) Try to find out what the ants are doing. (This observation can best be made out of doors, by watching the ants on the plants where aphids are feeding.) Aphids throw out from their body a sweet liquid known as honey dew. Ants are very fond of this sweet substance, so that wherever you find plant lice you will always find some ants. You will often find flies, too, sipping the honey dew that has dropped on the surface of the leaves.

LESSON 11.—If the corn root aphis has been found upon the roots of corn, a careful study should be made of these. A small brown ant will probably be found in the cornfields near the roots, or perhaps nests of these may be found in the cornfield. Even if it is too late to find the corn root aphis this fall, encourage the boys to

remember to look for it next year when the corn is growing. Encourage them also to destroy any ants' nests that may be found in the cornfield or vicinity.

LESSON 12.—Why should they do this? The female aphids lay their shiny black, oval eggs in the ground during the fall months. The little brown ants find these, carry them to their underground homes, and keep them safely through the winter. They often carry the eggs out into the sunshine during the warm part of the day and back into the burrows at night. These eggs hatch in the early spring into young aphids. The ants at once place these on the roots of smart weeds or some other plant. When the corn is beginning to grow, the ants place the aphids on the corn roots, from which they suck the juices with their sharp sucking tubes. The ants get their pay for all this work in the form of honey dew which the aphids throw out of their bodies.

Each aphid that hatches from an egg in the spring is called a stem mother. In less than a month this stem mother begins to reproduce young. All these are females which in a month's time begin also to produce young. So in less than two months the stem mother may become the ancestor of thousands of young lice. This goes on all summer. Most of these aphids are wingless. Once in a while there is a generation that has wings. These fly away to some other part of the field, or to another field. Some of them drop to the ground, and are found by ants that carry them at once to corn roots. In the fall a brood of true males and females are produced. These females are the ones that deposit eggs for the next year's crop of aphids. You can readily see why the destruction of the ant's homes is to be encouraged.

One of the methods employed to destroy these pests is to break up the ground as early as possible in the spring, and then before corn planting go over it once or twice with disc or cultivator in order to destroy the smart weeds and as many of the ants' nests as possible.

The life history of all other aphids is essentially the same as that of the corn root louse. One reason they are so destructive is because they multiply so rapidly.

One species of aphids is often found on the oats in early summer. It is known in some localities as the "green bug." It sucks the juice from the stems and leaves of the oats, and is often very destructive. Aphids have many natural foes, which we shall discuss in our study of beneficial insects.

WHITE GRUBS. LESSON 13.—In some localities white grubs are common corn pests. They feed upon a variety of plants besides corn, strawberry, potato, beets and grasses.

If the pupils have been collecting grubs, there will be a supply on hand for special study. To keep these insects alive place them in a tin pail or can, in which there is plenty of moist soil. Place on top of the soil a piece of fresh grass sod, firm it down with your hand, keep it watered but not wet. Set the pail aside for several days. At the end of this time carefully lift up the sod. You will probably find some of the grubs under it. Note the position of the body. Is there any advantage in keeping the body curled up in this fashion? Is the grub lying on its back or under side? Has it a tunnel to lie in? What has it been doing here? Look at the grass roots. Can you see whether any of these have been eaten? Look carefully at the structure of the insect. Has it a distinct head? How does the head differ in color from the body? Is the body hard or soft? What kind of a mouth has the grub? Look at the front of the head for the strong hook-like jaws. It is with these that the grubs bite off the roots of plants and underground stems. Do the grubs ever kill plants in this way? (They kill not only many hills of corn in some fields but great tracts of grass in pastures and lawns. They often kill many strawberry plants.) How many legs have they? Where are the legs situated? What is the use of these legs? Place the insect on the floor or desk. Can it crawl well? Now put it on the surface of the soil and watch to see how it succeeds in burrowing into the ground. What special adaptation do you find on the feet that enable them to dig so easily? Name all the adaptations these insects have for living in the ground rather than on the surface.

LESSON 14.—It may not be possible for the pupils to work out any part of the life history of the white grub. If the study is made early in September, it is worth while trying to get some of the pupæ. If the larvæ have been kept in the pails of soil for some time, a few may go to the bottom of the pail to pupate. A pupa looks like a light brown mummy with undeveloped wings and legs folded close

to the sides and under part of the body. No doubt some of the pupils will also find in the ground in the fall some of the grown-up insects. These are commonly known as June bugs or May beetles. They are very abundant in the spring and early summer. Have the pupils recall what they know about June bugs. Do these insects fly at night or during the daytime? (They are night flies and are attracted by lights. They come buzzing into our homes in the evening, often striking against the walls and dropping to the floor. They are dark brown in color and have very hard shell-like wings.) Who has ever noticed the June bugs folding up the inner wings when they first alight? If any of these insects are found by the pupils, make a brief study of them. Notice how the outer wings are related to each other. Do they overlap, or just meet in the middle of the back? Lift up the outer wings to find the inner ones. How do these compare in length with the outer wings? Which pair is used for flight? What is the use of the hard outer wings?

LESSON 15.—The June bugs lay their eggs in the ground, usually in June. In a short time the eggs hatch into tiny white grubs. They feed first upon decaying matter in the soil and a little later upon the roots of plants. When cold weather approaches they burrow down into the ground below the frost line and sleep during the winter. In the spring they come up to the surface and begin feeding upon roots. In the latter part of the summer they make a little tunnel in the soil and change into pupæ. They remain in the pupa stage probably about three weeks or a month and then change into the mature beetles. The mature beetles, however, stay in the ground without feeding until the next spring. The pupils will probably remember having seen many of these beetles in the soil of the garden and the fields in the spring at plowing time.

Since white grubs are such pests, the question of how to get rid of them is of interest to all farmers. As yet no good remedy has been found. Rotation of crops aids in keeping the grubs in check. They are not likely to be found in great numbers in clover fields, hence when clover is used in the crop rotation the grubs are not likely to become very abundant. Fall plowing aids some, if done early, in killing pupæ and larvæ. One of the best known remedies is to turn pigs into the field whenever that is possible. Pigs are so fond of grubs that they will dig down into the soil a number of inches in order to eat them. Many birds help to lessen the number of these pests. Robins are especially fond of grubs.

LESSON 16.—THE CORN ROOT WORM.—The northern corn root worm is a common corn pest. As its name indicates, it feeds upon the roots of the corn. Corn that has been injured by these pests shows the results in several ways. Sometimes there are spots in a cornfield in which the corn is dwarfed in size and produces nubbins instead of good ears. If the rest of the field is in good condition, this is a pretty sure indication that the worms have been working on the roots of the corn. Because of the injury to the root system, corn plants infested by the worms are easily tumbled over. This is especially true during a hard rainstorm. A moderate wind will often lay a whole field flat, because the weakened roots are not able to hold up the stalks.

The corn root worm is the young or larva of a small green beetle. Ask the pupils to look on the tassels and silks of corn, on flowers of wild asters and golden rod for small green beetles. These beetles are about the size of lady bugs and are grass green in color without any spots. What are the beetles doing on the corn and the flowers? While the pupils may not be able to determine this by observation, they should know that these insects feed upon the pollen of the corn tassels and other flowers and also eat the ends of the silks of the corn. If they are abundant at the time that the corn is blossoming, they may do some injury by preventing pollination, since they eat off the ends of the silks.

Place a few of the beetles in a bottle and make a simple study of them. Note the general appearance, color, size, feet and wings. What kind of mouths do you think they have, biting or sucking? (All beetles have biting mouths, both as larva and grown-up insects.)

The question of how the small green beetles are related to the corn root worm is of interest. The beetles lay the eggs an inch or more in the ground in the fall. So far as is known, the eggs are deposited only in cornfields. They remain in the ground all winter, and late in the spring the egg hatches into a small larva, the corn root worm. The larva is white in color and not much larger around than a pin. It feeds upon the youngest roots of the corn. Sometimes as many as a hundred of these worms

have been found in a single hill of corn. In feeding they burrow into the roots of the corn in a spiral fashion. The burrowing causes the roots to wither and die. When the larvæ are ready to pupate they crawl out of the roots of the corn, but still remain in the ground. They remain in the pupa stage a short time, and then come forth, the small green beetles that we have already studied.

Nothing as yet has been found that will destroy these pests after they actually get started to work on the roots. Rotation of crops seems to be the only remedy. If corn is not planted in a field in which the eggs are deposited, the insects will surely die, since they seem unable to feed upon the roots of other plants. It is only in fields then in which corn has been raised for a number of consecutive years that these pests ever become abundant.

LESSON 17.—THE EAR WORM.—Sometimes the corn ear worm becomes a very great pest. It attacks sweet corn more than field corn. The worms are found under the husks of the ears late in the fall. By looking closely the pupils will see that the worms eat through the husks; then burrow into the grains, eating great tunnels. If some of the worms are brought in for study, note the shape of the body and the color. Do the worms vary in this respect? Is the body segmented? Is its head distinct from the body? How many feet has the worm? Are all the feet the same size and shape? (The three pairs near the head are the true legs. The four near the middle and one near the back part of the body are called pro-legs.) Decide from the way the corn is eaten whether these have biting or sucking mouths. This worm is the larva of a moth. If the pupils keep the larvae in a pail with some soil in it, they may be rewarded by having the worms leave the ear of corn and go into the soil to pupate. In the field the larva makes a little tunnel in the soil and in this changes from a larva to the pupa. It remains in the ground as a pupa all winter. Early in April the mature insect emerges from the pupa. This is a yellowish tan moth that often flies into our homes in the evening attracted by the light. It is one of the moths that is commonly called a moth miller. The female moth lays its eggs on the corn plants. The first generation live chiefly on the leaves of the young corn. They grow up in a short time, pupate, and within three weeks change into the moth. There are three generations during the summer. It is the third generation that does the greatest mischief to the ears of corn during the latter part of the summer.

There are a number of other corn pests. Some will be found abundant in one locality, some in another. The teacher should choose for special study those that are most abundant in his own district. Among some other common corn pests are the chinch bug, the several varieties of cut worm, and the cornbill bug.

LESSON 18.—BENEFICIAL INSECTS.—We must not think that all of the insects found in our district are pests. There are a number of insects that are our greatest friends. Instead of feeding upon plant life, they feed almost wholly upon the insects that are injurious to our plants. Among the beneficial insects, the most familiar are the lady bugs, or lady bird beetles. Have the pupils look for these insects on the garden plants and weeds, especially those on which plant lice are found. Lady bugs may be kept in the school room and the entire life history studied, if they are fed upon plant lice. There are several different species that are common everywhere. The nine spot lady bug is a yellowish brown with nine black spots on the back. The two spot is a brick red in color with two black spots on the back. The fifteen spot is a pink gray with the fifteen black spots on the back. The common pink red beetle is known as the thirteen spot.

For study, place a lady bug in one of the bottles and have the pupils notice the characteristics. Compare it with the other insects studied. Have them decide why it should be called a beetle rather than a bug.

Wherever the mature lady bugs are, the larvae usually are present also. These do not look any more like a grown up lady bug than a caterpillar looks like a butterfly. Their bodies are long, shaped something like a lizard or alligator. The color is usually black or gray with a few dots of orange on the back. Stiff hairs or spines stick out from the body, giving them rather a fierce appearance. If these are found, watch them feed upon the plant lice. Decide what kind of mouths they have. How many feet have they? They remain in the larvæ stage but a short time, then they fasten themselves by the back part of the body to a leaf or some other support and change into pupæ. They remain in the pupa stage a short time, about a week or ten days, and then the grown up lady bugs come forth. The lady bugs remain in

the mature stage all winter. Have the pupils look under leaves and around the roots of shrubs and herbs for groups of these lady bugs, that have collected here to spend their winter.

Both the larvæ and the adult beetles eat plant lice, eggs of moths and gooseberry worms, and upon the eggs and young of the potato beetle, therefore we should be very careful not to destroy any lady bugs. They help, more than we can estimate, to keep in check many of our insect pests.

LESSON 19.—Another interesting beneficial insect is the lace wing fly and its larva. The mature insect may be found in the fall in gardens, orchards and meadows. It remains resting on the underside of leaves and it is only when disturbed that it flies. It is a light green insect with a very slender body and four beautiful light green, lacy looking wings. Its eyes are like drops of bright gold, so it is often called golden eyes. It is less than an inch in length. When disturbed, it whirls upward, reminding one of a whirligig. The young may be found quite late in September on any infested with plant lice. It resembles somewhat the larva of lady bugs but is lighter in color and its jaws are so long that they look like small horns. The pupils, if they find any of these insects, should place them in bottles, feeding them with lice. Observe the size, shape, and color of the insects. Watch them impale the plant lice on their horn-like jaws while they suck the juices from their bodies. These insects are often called aphis-lions, because they act like fierce lions preying upon the aphids. The pupils may see the larva go into the pupa stage. It spins a round white cocoon on the leaves and inside of this changes from a larva to a pupa. Some of them stay in the pupa stage all winter, so if the bottles are put away and kept until spring, the mature insect will emerge. The mature insect will then deposit her eggs for the first generation in the spring. The eggs of the lace wing are very interesting. Some of the pupils have probably seen them, even if they did not know what they were. They are placed on the ends of small strands of silk about one-half or three-fourths of an inch long. The strands are fastened to twigs or leaves. The female lace wing does this to prevent the first larva that hatches from destroying the rest of the eggs. If the eggs were placed flat upon the leaves, the first aphis-lion that hatched would probably eat up all the rest.

The lace wing larvæ feed not only upon plant lice, but upon various other insect pests, so that they should be placed along with the lady bugs as our chief benefactors.

LESSON 20.—There are several other insects that the pupils will probably find and bring in for study, that may be regarded as beneficial. One of these is a large green beetle about an inch in length. It has very long legs and is usually found in the garden and cornfields. The underpart of the body is dark blue. This beetle is known as the searcher, because it searches so diligently for caterpillars of various kinds. It has been known to climb cornstalks in search of the corn ear worm.

The dragon fly, often called snake feeder or snake doctor, is a benefactor, because it feeds wholly upon mosquitos, gnats and flies.

LESSON 21.—Besides the insects that benefit us by catching and devouring insect pests, we have another class that kill off pests in a very different manner. They are known as parasites, because they live in the bodies of insects, feeding upon the liquids and tissues of their hosts, and in this way killing off great numbers. Ask the pupils how many have seen tomato worms whose backs were covered with small white bodies. If tomato worms are found with these objects on them, bring them in for study. Look closely with a lens and you will see that these bodies are small, silken cocoons. Place the worms in jars, tie a cover over the top of the jar and in a few weeks you will find the jar filled with tiny insects looking like gnats or flies. These are braconid flies and are relatives of bees and wasps. Now examine the cocoons to find the openings through which the braconids emerged. The life history of these insects is as follows: Some time in the summer a little braconid fly places its eggs under the skin of a tomato worm. The eggs hatch into small white grubs like tiny maggots. These feed upon fluids in the body of the tomato worm and when they are grown up as larvæ they eat holes through the skin of the tomato worm, come out and spin their cocoons. In these cocoons they change into pupæ and, as we have already seen, come out a few weeks later as grown-up flies. A tomato worm in which these braconids have fed, never reaches maturity, but dies either before it pupates or soon afterwards. So numerous are these little flies in some localities that the tomato worm has become almost extinct. Ask the pupils to look on cabbage leaves for bunches of small yellow cocoons. These are cocoons of another braconid fly, whose

larvæ live in the bodies of cabbage worms. These little insects kill off hundreds of cabbage worms every season.

Ichneumon flies are little insects larger than the braconids. They deposit their eggs in many different kinds of caterpillars and thus destroy those injurious insects. A very common ichneumon keeps the white marked tussock moth in check in Illinois.

We have suggested above special studies of some of the most common insects. In many localities, however, other insects will certainly be brought in by the pupils. Encourage the study of such insects. Have the pupils find out all they can about their habits and food by observation, following the plans suggested in the study of the grasshopper or squash bug. If larvæ are brought in, they should be fed the leaves of plants upon which they were found. The pupils should work out as many life histories as possible. Larvæ found in the fall, as a rule, spend the winter in the pupa stage. In many cases the pupa may be obtained in the jars and vivarium and kept until spring, then the mature insects may be identified. It will be worth while to have the pupils start a collection of insects, grouping together those that are pests and making another group of the beneficial insects. Any tight pasteboard box may be used for the collection. Put an interlining of pasteboard in the bottom, in which to stick pins. Kill the insects by placing them in the cyanide jar. Stick a pin through the thorax when you are sure that the insects are dead and then place the pin in the lining of the pasteboard box. It is a good plan to put some camphor gum or moth balls in the box to keep out a little museum beetle which may destroy the collection.

Below is a list of other common insects with brief descriptions.

THE PESTS

THE WHITE MARKED TUSSOCK MOTH.—The larva is a slender caterpillar with a coral red head and yellowish, hairy body. On the back are four white tufts and back of the head are two black horns of hair. There is another hair like horn on the back near the hinder part. The larvæ spin cocoons late in the fall. The moth emerges and lays her eggs in a white frothy mass on the outside of the cocoon. They remain in the egg stage over winter.

BOX ELDER BUG.—A red and black bug that resembles a squash bug. The bugs are sometimes found in great numbers late in the fall. The different stages may be found, some grown up, some with the beginnings of wings. These stay in the mature stage over winter.

THE FALL WEB WORM.—These insects are larvæ of a gray moth. The whole family, sometimes consisting of several hundred, live in a web which they spin for themselves over the branches of trees. They are found on box elders, apples and other trees.

THE CODDLING MOTH.—The young of this moth lives in apples and we know it as an apple worm. If you put some apple worms in a box and feed them upon apples they will pupate toward spring and you will be able to see the little moth that lays its eggs on the apples.

PEACH TREE BORER.—Look on the main stem of the peach tree for small bunches of gum that has come from the tree. With a knife carefully cut into the tree, just a little under the bark at this place and you will find a white worm. This is the larva of a moth. It feeds upon the juicy inner bark and sap of the tree. One of the best ways to get rid of these borers is to dig them out of the tree with a stiff wire or knife.

GARDEN PESTS

THE COLORADO POTATO BEETLE.—This is the common roundish, yellow and black, striped potato bug. It lives over winter in the ground in the adult stage.

THE STRIPED CUCUMBER BEETLE.—A small yellowish green and black striped beetle. It feeds upon the leaves of cucumber, squashes and melons. Its larvæ bore into the stems of the plants and often destroy the young vines.

THE SPOTTED CUCUMBER BEETLES.—This is similar in its habits to the striped cucumber beetle. It is greenish with twelve black spots.

STRAWBERRY LEAF ROLLER.—This is a tiny moth that lays its eggs on the strawberry plants. The larva rolls the leaf over and lives and feeds inside the rolled leaf. It pupates inside the leaf and spends the winter there.

THE CABBAGE WORM.—This is the larvæ of the common white butterfly. If the worm is obtained early in September the entire life history may be worked out in the school room.

THE CABBAGE MOTH.—This moth is not as large as the white cabbage butterfly. It flies at night instead of during the daylight. The larva differs from the cabbage worm somewhat in color. It has light stripes on its back. It does not have as many feet, so it has to loop up when it walks. It makes a thin walled cocoon in which it pupates. Its life history may also be worked out in the school room.

FIELD PESTS

CHINCH BUGS.—Small insects dark in color that feed upon wheat and corn.

THE CORN BILL BUG.—This is a small, dark beetle with a long snout. It spends the winter in the adult stage and may sometimes be found late in the fall. It hibernates over winter and in the spring comes forth to feed upon the young corn stems.

CUT WORMS.—These do most of their mischief in the spring, but the mature moths are often found flying around in September. They are dull colored moths that we often call moth millers.

HESSIAN FLY.—This is a very small insect that is not likely to be found by the pupils. However, it is such a pest that it should be named among field insects. There are several broods during the summer. The last one attacks the young wheat in the fall. The eggs are deposited in the stems near the surface of the ground and the larvæ feed there, changing to pupæ in the stems of the wheat. In the spring the adult fly emerges from the pupa, lays its eggs and again the larvæ feed upon wheat stems. Wheat should be planted as late as possible in the fall. When this is done the adult female may die before the wheat is large enough to receive the eggs.

OCTOBER

OUTLINE FOR OCTOBER.—(*Note. Two lines of study are suggested for the month, only one of which need be studied in any one school. Each school should choose the line of work best fitted to the locality.*)

1. Special study of corn; its culture and improvement. Visit fields and participate in selection of desirable stalks and ears. Drying and storing seed. Experiments to show shrinkage of corn. What is gained, if anything, by keeping corn over winter to sell. Varieties of corn grown in neighborhood; history of two or three varieties. Characteristics of a good ear; simple introduction to use of score card. Factors involved in marketing corn.

2. Wheat. Children bring samples from home; examine for weed seeds and other impurities. Test one hundred grains of each sample for vitality. Methods of planting, machinery used in planting. Observe habits of growth of plants. What parts of the plants live over winter. History of wheat varieties.

CORN

The work may begin with an informal discussion of the corn crop in the district. About how many acres of corn are grown upon the various farms? What different varieties are grown? What is the prevailing variety? Does any one raise red, calico, or other varieties than white and yellow?

Study of the corn plant. (1) *Roots.*—Have an entire plant dug up and brought into the schoolroom. As much of the root system as possible should be preserved. A fresh green plant is better for this study than one that is dry and mature. The purpose of these lessons is to interest the children in the characteristic and habits of growth of corn.

Notice the root system. How many kinds of roots? Are the main roots large or small? These are known as fibrous roots. What is the direction of growth? Ask

the children to dig carefully around a corn plant at home to see the relation of the roots to the soil. How near the surface are they found? How deep do they grow? How far out from the hills? How far between the rows?

Where are the brace roots? How many joints on the stem produce brace roots? Have children observe corn at home and report on the greatest number of brace roots growing upon one stalk. Do they all succeed in reaching the ground? When do the brace roots begin to appear on the corn? Leave this as a problem to be solved next summer.

(2) *Stem.*—What is the height of the stem? Have children report on various heights of stems in the home field. What is a good average height? Note that the stem is built up of sections separated from each other by joints. We call these joints nodes, and the portion of the stem between internodes. How many internodes in the stalk? Are they all the same length? Do you see any advantage in having the nodes close together near the base of the stalk? Does this make the stalk any better able to resist the force of the wind. Look for a groove on one side of the internode. Is it on the same side of all the internodes?

With a sharp knife cut a stem into sections. How many different structures can you find in this cross section of the stem? (The outside layer forms the woody part.) Is it hard or soft? (Inside is a soft pith and scattered throughout are thread-like structures called fibro-vascular bundles.) These bundles are really little systems of canals, which carry water and other raw materials from the roots to the leaves. The leaves manufacture these raw materials into food and the canals carry this food back to the stem, roots, and seeds, wherever it is needed.

(3) *Leaves.*—How many leaves on this plant? Does the number differ on different plants? Have the children report on this. Do the leaves differ in length? Where are the longest leaves? How are the leaves fastened to the stem? (The part that surrounds the stem is called the sheath.) Is the sheath open or closed? Is the closed or open side next to the groove on the internode? The long, slender part of the leaf is called the blade. Notice how it arises from the sheath. What part of the blade is longer, the middle or the margin? Can you see any advantage to the leaf in having this wavy margin? Would it tear any more easily in the wind if it were straight? Note the rain guard, a thin fringe at the top of the hinge. (Its use is to prevent rain from pouring down between the sheath and the stem.) Why might the rain here be a disadvantage to the plant?

What do the leaves do for the plant? (Their chief work is to manufacture starch, proteid, and other foods for the plant to live upon while it is growing and to store up in the seed for future use.) If this is true we can see the importance of every corn plant having a good leaf surface.

(4) *Flowers and seed.*—Has the corn plant any flowers? (Note to the teacher: If the children are not familiar with the parts of a flower, then spend one lesson in studying some familiar flower, as the nasturtium or petunia.) Look for the sepals that form the calyx, and for the petals, the colored part of the flower. Find the stamens with the filament and knob-like anthers, which bear the pollen; the pistil with the roundish ovary at the base, the slender style and the stigma at the top of the style. The corn flowers are so very different from the ordinary ones that we do not usually think of them as flowers at all. But while they have no bright petals, they have the stamens and the pistils which are the essential parts. In fact, every corn plant has two kinds of flowers, one at the top of stalk, which we know as the tassel. The other is often called the shoot, which afterwards becomes the ear. Every boy and girl has seen the yellow powder that falls in showers from the corn when it first "tassels out." Look at the tassel. Note that it is made up of a great many branches on which are small parts which are called spikelets. Have you ever noticed little bodies dangling from the spikelets in the summer time? They are the stamens, which produce the pollen, so we call the little flowers in the tassel staminate flowers, because they have stamens and no pistils. The "shoot" which bears the pistils, is known as the pistillate flowers. Try to find a very young ear and bring into schoolroom for study. Carefully remove the husks. Note the rows of roundish bodies fastened to the cob. Note that a silk is attached to each round body. The round body is the ovary, the silk is the style, and the end of the silk the stigma.

What must happen in order that a grain of corn be formed? (First a grain of pollen must settle on the end of the silk. We call this process pollination. If the pollen comes from the tassel of the same plant we say the flower is self-pollinated. If it comes from another plant we say the flower is cross pollinated.)

Do you think most of the corn in the field is cross- or self-pollinated? What is the chief agent that carries the pollen from one plant to another?

Experiments have been made by experts which prove that cross pollination (other conditions remaining the same), produces better, stronger, more productive corn than that which is produced by self pollination. So you see it is a good thing that the wind scatters the pollen all over the field.

What happens to the pollen grain when it falls upon the end of the silk? It germinates and forms a slender tube which grows downward through the entire silk until it reaches the ovary. This tube is called the pollen tube. In it are two tiny cells, so small that you would have to have a microscope of very high power in order to see them. When the cells reach the ovary it is ready to receive them. In fact it has been getting ready for them while the tube has been growing through the silk. In it are two important cells also. One of these is called the egg cell and the other the endosperm cell. One of the cells from the pollen tube unites with the egg cell to form a new cell, which has the power of growing and dividing again and again until it forms a little plantlet which we call the germ, or embryo part of the corn kernel. The union of this pollen tube cell with the egg cell in the ovary is known as the process of fertilization and this must always occur before the embryo can be formed. The second pollen tube cell unites with the endosperm cell of the ovary and the resulting cell grows into the large starchy part of the corn kernel, which surrounds the embryo and is called the endosperm. The endosperm part of a corn kernel is simply a storehouse of food placed around the little embryo to serve it with nourishment while it is developing its first roots and leaves and getting ready to manufacture its own food. It is because of the fact that plants in this and similar ways store so much nourishment in their seeds to nourish the little embryos which are their offspring, that seeds are so valuable as food for man and animals.

When the seed germinates and grows the endosperm is destroyed and so it only lives one season, but the embryo grows into a new plant the next year. Just what kind of a plant it will be and what kind of corn it will produce depends largely upon the kind of plant which produced the pollen grain and the ovary cell that united to form the beginning of the seed. You can easily see from this why the characteristics of both plants are so important, and why corn breeders who raise corn, especially for seed, are very careful to have both the pollen and the shoot grown upon plants that have the very highest qualities.

(5) *The ear.*—Where is the ear situated on the stalk. Is it on the grooved or the smooth side of the internode? About how far from the ground is it? Do ears on different stalks differ in this respect?

Note the length of the ear-stem or shank. Can you see any disadvantage in a long ear shank? (A long shank usually means a short ear and indicates poorly bred corn.) Is there any disadvantage in a very short shank? Have the children notice how short-stemmed ears stand almost erect and thus readily catch the rain.

To continue the ear study ask each child to bring at least two ears of corn from home. If the teacher can procure sample ears of two or three standard varieties it will help much in this work. How many rows of kernels on each ear? Is the number odd or even? Are they the same on all ears? How many kernels in one row? How many on one ear? How can you determine this without counting all of them? If you disregard the small kernels at the tip and butt how many kernels on one ear may be used as seed corn next spring?

Selection of seed corn.—Can you think of any good reason for choosing seed corn early in the fall from the field? Let us see what some of the reasons are. Is it worth while to consider the stalk from which the seed corn is to be gathered? (If a stalk is weak or has other faults seed from it will probably produce the same bad characteristics in the stalk next year, so one of the first things to consider in selecting seed is a desirable stalk.) Have the pupils name the points they would like reproduced in a stalk next year. The following are points that should be considered: (a) The stalk should be erect, strong, well-formed, i.e., thick at the base and gradually tapering toward the top. (b) It should have well developed brace roots. (c) It should have grown in a hill with at least two others. Do you see why? A stalk standing by itself in a hill might produce a good ear because it had so much space from which to draw food materials. What we want is a stalk that is vigorous enough to produce a good ear when it is growing in a hill with other stalks. (d) It should be free from smut and suckers. (e) The ear should be situated a little above the middle point. The ear stem should not be too long or too short, on an average about three and one-half inches.

If there is a corn field near the school, a field study in identifying desirable stalks makes an excellent exercise. The work may be carried still farther. Choose a plot in the field ten hills square. Count the whole number of stalks in the plot, the number of missing stalks, the number having one good ear, the number of barren stalks, the number having suckers, and those having smut. How many stalks have two good ears? How many ears in the plot? Estimate the number of bushels in the plot; the number of bushels if there had been no missing stalks or ears.

The score card.—For the desirable points in the ear the Illinois Corn Score Card may be used. This may be obtained by applying to the president of the Farmers' Institute of your county.

The value of the score card in the hands of the children is not merely that they may become skilled in judging samples of corn, but that they may have their attention called to the essential points that characterize a good ear. At the same time this exercise is of considerable educational value. The pupils make accurate observations, compare different points in different ears, form judgments, and act upon those judgments.

Have the pupils bring at least five ears that have been chosen from desirable stalks at home. Select from these ears one that approaches a typical ear of the variety. Now place all the rest of the ears side by side with the butts in a straight line and compare them, one at a time, with the typical ear. Group together those that show similar characteristics. This will help the pupils to understand what is meant by trueness to type, which is indicated by the shape and size of the ear, the shape and color of the kernel.

The grouping together will also aid the pupils to see what is meant by uniformity of exhibit. If the pupils were preparing a sample of ten ears for a corn contest they should place together ears that are similar in external characteristics.

The shape of the ear will vary somewhat with the variety. In general it should be cylindrical, tapering slightly toward the tip. The rows should be straight, running parallel to each other, not twisting to the right or left.

The color of the ear should be true to the variety, pure white or yellow as the case may be. The kernels should be free from mixture. White corn should have white cobs, and yellow corn red cobs.

The seed condition is very important. The ears should be dry and sound. Take the ear in both hands and twist it from right to left. If it is soft and limp it shows lack of maturity and should not be chosen for seed.

The tips should be well-filled, the rows of kernels extending in a straight line over the end. There should not be a piece of cob exposed. However, if the ear has other good qualities judges do not consider a tip that is not wholly covered a bad fault.

The rows should extend in regular order over the butts, leaving just space enough for the attachment of the ear stem.

The size and shape of the kernels in all of the ears should be similar. To examine for uniformity of kernels remove two grains from about the middle of each ear and lay them in front of each ear with the tips pointing towards the tips of the ears. The shape of the kernels will depend somewhat upon the variety. In general they should be deep and wedge-shaped, so that their edges will touch the entire length of the grain. They should not taper at the tip, but should have plenty of space for strong, large germs.

The length of the ear varies with the variety. In an exhibit the ears should approach uniformity of length. The circumference also varies with the variety. In general the circumference, measured three inches from the butt, should be about three-fourths of the length of the ear.

There should not be a wide space between the rows of kernels, neither should there be a space between the tips of the kernels at the cob. Both of these indicate poorly bred corn and a low proportion of grain to ear.

The proportion of shelled corn to ear depends upon a number of points such as well-filled butts and tips, spaces between the rows and kernels, the size and depth of the kernels, and the size of the cob. To determine the proportion by weight, weigh five ears, then shell the grain and weigh the cobs; subtract the weight of the cobs from the weight of the ears to determine the weight of grain. Now determine what per cent the weight of the grain is of the total weight.

Storing seed corn.—After the seed corn is selected comes the question of storing for the winter. What conditions are essential for the keeping of seed corn? Three

at least should be considered. First, the atmosphere should be dry; second, the temperature even, and third, the ventilation good. A simple method is to tie a number of ears together and hang them up in some convenient place such as the attic, a dry shed, or an unused room. Wire used to support the strings will prevent injury from mice and rats. A simple plan suggested by the College of Agriculture in Ames, Iowa, is known as the double-cord method. Tie the ends of a cord together. Now hold the cord over the hands like a skein, letting the middle drop to the floor. Let someone place an ear of corn over the string on the floor. Now slip the cord that you hold in your right hand over the one in the left, letting them cross above the ear of corn. Place another ear of corn on this and cross the cords again. Continue to weave back and forth till you have all the ears in. Then slip one cord under the other and it is ready to hang up.

A simple experiment may be tried to estimate the per cent of shrinkage of corn that is kept for the spring or summer market. Weigh ten ears, hang them up in the school room or at home, and at the end of a month weigh again. Continue this until the end of the spring term. Estimate each month the per cent of shrinkage.

Uses and history of corn.—A short time may well be given to a study of the uses of corn and something of its history.

Have the pupils make lists of all the uses of corn that they know. What parts of the plants are used to feed stock? (The grain on the ear shelled or ground, the stem and leaves in fodder, the whole plant in silage, bran and corn-oil cake?)

Make a list of the various ways in which corn is used for human food. (Cornmeal, breakfast food, hominy, corn starch, syrup and oil.)

Corn oil is also manufactured into rubber from which boots, shoes, linoleum and oil cloth are made. It is also used in the manufacture of soap and the mixing of paints. The cellulose from the pith of the stem is manufactured into an almost impenetrable substance that is used to protect warships from shot and shell. The cobs, and even the stalks are largely used for fuel in some of the western states.

Have the children start a collection of corn products for the school. Wide-mouth bottles may be used. Pickle bottles will serve very well. Place samples of the various products in the bottles, label neatly and preserve for future use. A corn chart may be made by fastening to a large sheet of cardboard various corn products.

Many school readers and geographies contain interesting articles on the history of maize or Indian corn. The children should know at least that corn was found by the earliest explorers in America. The Indians had attained quite a degree of efficiency in its culture. The first successful attempt to cultivate corn in America by the English was made by the Jamestown Colony in Virginia in 1608. Before the close of the seventeenth century corn was the most important crop raised by all of the colonies.

At the beginning of the nineteenth century there were probably not more than five varieties of corn known. Now there are several hundred, all produced by careful selection and breeding.

It may be worth while to know that from a botanist's standpoint there are seven species-groups of maize. Four of these are grown in Illinois. These are: the popcorns, which we all know; the flint corn, which is a very hard, smooth-grained variety, that is grown in some places more for fodder than for grain; the sweet corns, which are used so largely for human food; and the dent corns, which constitute all the varieties of common field corn both yellow and white. This group receives its names from the dent in the upper surface of the grain. In some places popcorn is grown chiefly for curiosity. Each grain is covered with a husk. This is supposed to be the primitive type from which the others have sprung.

Plan for a corn display and program on Corn Day. If any member of the school have grown corn, have a corn contest. If no corn has been grown by the pupils, then have the contest consist of a display of five or ten ears chosen by each member of the class to show his skill in selecting a good corn sample.

WHEAT

LESSON 1.—The first lesson in the wheat should consist of a discussion of wheat as a farm crop in neighborhood. How many farmers in the district raise wheat? What kind do they raise, spring or fall wheat? About what time is it planted? Discuss different methods of sowing used in the neighborhood, also different methods used in the preparation of seed beds. If different farmers use different

methods, encourage the pupils to watch for results in order to determine whether more labor expended in preparation for the seed bed brings a better yield. If some in the neighborhood use the drill and others sow broadcast, in the same way, encourage the pupils to watch for results and decide whether one method is better than the other in that particular locality. How deep is wheat planted? Is there any danger of planting it too deep? Ask the pupils to bring small samples of wheat from home for study the next day.

LESSON 2.—Make a brief study of grains of wheat, noticing the covering and the difference in the two sides, one smooth and the other creased. Compare the grains of the various samples brought in by the pupils and note the difference in color, size and plumpness of the grains. Now test for purity. This is to determine whether or not the wheat seed contains other things than pure seed. To do this spread a small handful of the grains on a sheet of white paper. Now separate all the weed seeds, chaff and other foreign objects from the wheat. When this is finished put the wheat seed in one pile and the foreign matter in another and estimate about what per cent of the wheat seed is pure. This may be used as a good percentage problem in arithmetic for the pupils. If the school has a pair of scales, find the weight of the wheat and of the foreign bodies and the per cent may be found by comparing the weights of the two. A germination test should be made to determine whether or not all the seeds are likely to grow. To make this test, take one hundred grains from each sample of wheat. Place some moist sand or soil in a dinner plate; a box or pan will serve as well as a plate. Scatter the seeds on the surface of the sand, not allowing any to touch each other. With your finger gently press each grain, so that it will rest firmly in the sand, but do not cover it. Turn another plate over this one to keep the moisture in it. Set it away in a warm place. Watch for the germination of the seeds. How long after planting before the first small sprouts appear? Watch them from day to day until you are certain that no more grains will sprout. By counting the grains that have not sprouted, you will be able to determine at once the per cent of germination. If all have sprouted but two grains, what per cent of germination has the wheat? If not more than sixty grains sprouted would you expect a good stand of wheat?

Observe the sprouting grains to find how many roots grow from each. From which side of the grain does the sprout come, the creased side or the smooth side? A few grains planted in a pan of soil at this time and kept watered will be of value for study a little later in the term.

LESSON 3.—If the teacher or pupils have some stems of wheat with the heads on them, an interesting lesson may be given in connection with the forming of the grains of the wheat. Notice the head. Is it one piece or is it made up of branches or clusters? This kind of a flower cluster is called a spike. The small side branches are spikelets. How many spikelets in one head? How many divisions in one spikelet? Each division or part of a spikelet is the remains of a little flower. Did all the flowers succeed in producing grains? Count the grains in one spikelet. Compare different kinds of wheat in this respect. Some spikelets bear a number of grains, others have but three and some one and two. The number of grains in a spikelet has much to do with the yield of the wheat. The spikelet is often called by farmers a mesh, and hence farmers speak of the number of grains in a mesh. Here is another good problem in arithmetic: Since you have counted the number of spikelets in a head and have the average number of grains in a spikelet, how many grains will one head produce? Carefully pull to pieces what is left of the little flower around the grain. Each small, leaf-like body is called a glume. Examine the one nearest to the grain. Is there anything on the top of this? Bearded wheats have the awn or beard fastened to this glume. Are there any beardless wheats growing in the neighborhood? Compare all the different kinds of wheat that the pupils may bring in with reference to the above points.

LESSON 4.—This lesson should be given several weeks after the preceding one. Study the plants growing in the schoolroom and note the following points: The height of the shoot above the surface of the ground. Is the shoot erect or not? Dig some of the plants up and examine the root system. Where are the main roots now? Do they seem to have grown from the three small ones that first came from the grain, or farther up on the stalk? How long are the roots? How do they compare with the length of the shoot? Have the pupils make similar observation of the wheat in the fields at home. This observation should be made at intervals of a week or ten days. When the plants are six weeks or more old, what change in the habit of growth of the stem do you find? (Instead of growing erect the plants now spread

out in rosette fashion on the surface of the ground.) What advantage is this habit to the plant? The pupils will probably suggest that it helps to protect them. But does it protect the plant? The following points, at least, should be brought out: Since the plant is low on the ground it is shielded from high, cold winds. It is easily covered with nature's covering—the snow. This keeps the wheat and the soil at an even temperature, preventing the thawing and freezing which is so disastrous to the wheat plants.

LESSON 5.—Discuss the different varieties of wheat that the pupils may know. It is possible that there may be but one variety in the neighborhood. Some winter wheats are known as hard wheat, some semi-hard and others soft. Soft wheats are grown largely in warmer climates. In the middle west, the semi-hard wheats are the ones chiefly grown. Farthur north the hard wheats are gaining favor. Some wheats are classified with reference to the beard. Those having beards are known as bearded wheats, and those without beards are beardless wheat. How are new varieties of wheat obtained? There are two ways. Perhaps some of the boys may have noticed in walking through a wheat field, that here and there a few heads seem somewhat different from the rest of the wheat in the field. Wheat is likely to have sports or variations. That is the reason why these plants may differ greatly from all the rest, though grown from apparently the same kind of seed. Breeders who are anxious to obtain a new variety select one of these heads that seems to have good characteristics. They save the seed and plant them in a small plot by themselves. That is the beginning. If the plants carry out the good characteristics, the seed from this small plot is preserved and is planted on a larger plot. In a few years the breeders have enough seed to plant a number of acres. If the variety proves valuable, then the breeder gives it a new name and so has produced a new variety of wheat. This is called the selection method of producing new varieties. The other method is by a cross pollination. Ask the pupils if they know whether wheat cross pollinates as corn does. They will probably know that two varieties may be planted side by side with little crossing. This is because the flower of the wheat is so arranged that the pollen does not escape from the flower, but falls upon the pistil of the same flower. For this reason, when breeders wish to cross pollinate wheat, it must be done by hand. This is a very delicate and skilful piece of work and is carried on by experts. It is enough to know that they carefully remove the stamens from one flower and place on the pistil of that flower some pollen which has been taken from the stamens of another flower. In this way characteristics from the two plants are mingled in the new seeds that are formed.

LESSON 6.—Discussion of the uses of wheat will be found very profitable here. The pupils will probably know most of the uses, the most important one being the making of flour. The different kinds of flour may be named and from the geographies the chief centers in which flour is made may be learned. The uses of wheat in the making of breakfast foods and macaroni may be presented. The uses of the straw and the value of wheat in crop rotation should be discussed.

FRUIT TREES

While Illinois cannot be classed as a fruit growing state nevertheless it produces vast quantities of fruit each year. Almost every farmer has an orchard of some sort. Many of these orchards are old and sadly neglected, scarcely worthy of the name. Many farmers feel that they have no time to give to the care of fruit trees. In many cases it is a lack of interest and inclination rather than time. It will certainly be worth while from an economic as well as educative and aesthetic standpoint, to elicit the interest of the boys and girls in the fruit trees of the neighborhood.

For the first lesson make a simple survey of the fruit trees of the district. Ask the children to report the next day. How many different kinds of fruit trees on the home farm? How many of each kind? Where are the trees? Make a special observation of the apple orchards. Are the trees old or young? Find out if you can from your parents how old the orchard is. Look carefully at the trees. Are any of them broken? Are there any dead branches or suckers present? Select one tree for special observation. How tall is it? You may easily estimate the height of the tree by measuring your own height upon the trunk then estimating about the number of times the tree is taller than you. How thick is the trunk? What is the color of

the bark? Is it rough or smooth? Does an apple tree grow symmetrically or does it usually have a gnarled appearance? If there are apples on the tree notice where they are borne. Are they on small or large branches? Are any of them at the tips of the twigs? When we study the apple flower next spring we shall find out why apples grow as they do. Bring to school an apple twig for the next lesson.

THE TWIG.—Can you determine how many years growth your twig represents? To do this look for the ring scars. Can you see any difference between the old and new parts of the twig, as to color or smoothness? How are the leaves arranged on the branches? Do you find any that are clustered as well as those that are arranged singly on the twig? Look for buds. Where are they? Are they single or clustered? Are they all of the same kind. Do you know what the buds will produce in the spring?

THE APPLE.—The apple is the fruit of the tree and a most interesting fruit it is. Like all fruit it is the result of a flower. Recall how the apple flower looked last spring. You will probably remember that there was a cluster of pink blossoms at the end of the twig surrounded by a few soft green leaves. Is there a cluster of apples on the tree? Usually but one flower of the cluster succeeds in producing an apple. Once in a while two apples develop from the flower cluster. Examine the apples to determine the external features. What is the color of the skin? Is it thick or thin? It will be of interest to compare different varieties of apples as to the thickness and toughness of the skin. This is an item of some importance to apple growers who ship their fruit. Some apples are so thin skinned that it is very difficult to ship them without bruises. What is the use of the skin to the apple? To answer this try two or three experiments. Peel one apple, stand it in a window sill or some other part of the room and place beside it an apple that is not peeled. Let them remain several days and note what happens. Bruise an apple and place the bruised portion against another apple and note what takes place.

Notice the length of the apple stem. That of course, was the stem of the flower. Notice the shape of the apple where the stem is fastened. This hollow portion around the stem is called the cavity of the apple. What do you find at the other end of the apple? The withered bodies are the remains of the flower. The hollow space in this end of the apple is called the basin.

Cut the apple in two lengthwise. Examine the inside for the tough, shiny wall of the core. Can you determine the number of seeds in one cell of the core? Which way is the pointed end of the seed, toward the stem or the basin? Find a line that extends around the core connecting the cavity and the basin. This is the place where the calyx cup, the outer part of the flower, and the ovary, the lower part of the pistil, grew together in developing the apple. It is called the core line. Is the core line equally distinct in all the apples you have?

Cut an apple crosswise through the middle. You can now see the star-shaped core. How many points has the star? How many cells in the core? Can you trace the core line in the cross section? Make a drawing of a longitudinal and cross section of the apple labeling all the parts.

VARIETIES OF APPLES.—Have the pupils bring in for study specimens of different varieties of apples. Group them into winter and fall apples. There are probably no summer apples left at this time. What is the most striking difference between the fall and winter varieties? The fall are more mellow; they are almost ripe. The winter apples are mature but will ripen later in the season. Apples are mature when the seeds are brown. Have the children make lists of different varieties of apples, grouping them according to the time they mature, as—Summer apples; Duchess, harvest, early June. Fall apples; Grimes golden, snow, russet, Jonathan, maiden-blush, wealthy. Winter apples; northern spy, winesap, gano, willow-twig, salome, wolf-river, stark, Ben Davis.

PICKING AND STORING APPLES.—Discuss methods of picking and storing apples. The main rule to follow in picking apples is not to bruise the apple or break the skin if you expect the apples to keep well. This means that they must be hand-picked, not shaken from the tree. Do you find all the apples on one tree equally large and brightly colored? Do you find any very imperfect apples? In what way are they imperfect? Apples with warty knots have been affected with a fungous disease. Are these apples as large as the others?

Grade your apples by placing together the finest, the next best, and so on. Firms who make a specialty of selling apples have several grades. One Chicago

firm grades as follows: Extra fancy, in which all the apples are perfect; Fancy, in which they are nearly perfect. Choice, all good fruit, not all well colored. Number two, fruit that is hand picked but not all well colored, and not all the same size, but no apple must be less than two and one half inches in diameter. Any apple smaller or less perfect than number two is called a cull.

How are apples packed for market? Some are packed in barrels others in boxes. When apples are properly packed they will lay in layers and there will be no large spaces left vacant. The apples will fit closely but not bruise each other. Fancy apples from western orchards are often wrapped singly in tissue paper just as oranges are.

Where and how are the home apples stored for the winter? Discuss with the pupils what conditions are essential in order that the apples may keep well. Three things are easily remembered. First, temperature, the apples should be kept as cool as possible. A temperature of about forty degrees is considered good. Second, ventilation; they should be placed in a room where there is plenty of fresh air. Third, moisture, if the air is dry the apples will lose their freshness by evaporation.

One or two lessons may well be given to the discussion of the value and use of apples in the home. If time permits discussion of the great apple-growing state will be worth while.

The raising and planting of apple trees will be taken up for discussion in the early spring. In preparation for this, if there is a nursery in the vicinity, have the pupils observe something of the work of the nurseryman during the fall and winter months.

NOVEMBER

OUTLINE FOR NOVEMBER.—*CORN DAY.—Exhibit of corn grown by boys.*

WEEDS.—Make collection of seeds; label. Determine whether the plants are annuals. Which are the worst seeds in grain fields, in pasture, meadow, garden? What is the secret of strength or success in each kind? Means of combating each.

Study of the roads of the vicinity; types of road materials used in construction; road drainage; characteristics of a good road; the maintenance of roads; the drag; use of oil. Significance of the good roads movement.

CORN DAY.—Arrange to celebrate corn day, which occurs the first Friday of the month. Every effort should be made to make this a gala day in which the whole community is interested. A program should be arranged and the patrons of the school invited in. In some districts it may be advisable to have the meeting in the evening, others may find the afternoon more convenient. Plan to have the class bring in some corn for display. If the children have had no corn plots of their own from which to choose samples, then have them show their skill in selecting ten good ears from their fathers' cornfield. The program should in part indicate the line of work done in corn study during the preceding month. This work should furnish material for some interesting papers. The following subjects are suggested:

How a grain of corn is formed.

The story of a corn plant from the seed until it is matured.

How to select and store seed corn.

The uses of corn.

In districts where apples and apple-trees have been studied, a display of the apples of the district may be made along with the corn exhibit.

The new work for the month is a study of weeds and roads. It will probably be worth while in all parts of the state to give some time to both lines of work.

Lesson 1. Discuss farm activities of September and October, consulting the farm calendar for the first two months. Plan to continue the calendar for November.

WEEDS.—Weed study should be emphasized in the fall because at this time the plants are in flower and fruit. As a preliminary lesson ask the children to look in their gardens to see how many different kinds of weeds are growing there and to bring two kinds to school next day. Select from those brought in one for a type study. The following outline is suggested: Observe the height of the weed, the color of the stem. Break the stem to see whether or not it contains considerable liquid or juice. Are there many branches? Are the leaves large or small? Are they entire or divided? Compare the leaves on different parts of a plant with each other. Where are the seeds found? Are there many or few? Decide how to estimate the number of seeds on one plant. What makes this a successful weed? (Some weeds

have certain characteristics that help to make them thrive where some of cultivated plants would die.) For example the juicy stem of the pigweed or purslane with long roots enables these weeds to stand the drought much better than many cultivated plants. The great number of seeds of the pig-weed and some other weeds is another characteristic that makes them successful.

Having finished the study of one weed according to the above outline make comparative studies of other weeds found in field, roadside, pasture or garden.

Discuss with the children the ways in which weeds injure our crops. They crowd the cultivated plants and prevent their getting enough light and heat. They take up the moisture and nourishment from the ground that the cultivated crops may need. Some weeds make the harvesting of the crop disagreeable, and some weeds are injurious when mixed with hay or other food crops because they are not good for animals that feed upon them.

Have the children start a collection of weed seeds. There are several ways in which these may be preserved. They may be put into small bottles with the labels pasted on the outside, or they may be pasted upon cardboard. It will be worth while in arranging the collection to group together those of the same kind. The value is not so much in the collection itself, but that it is a device by which the pupils become better acquainted with the characteristics of the weeds in the neighborhood. At the same time it adds greatly to the interest of the study.

GOOD ROADS.—The study of public highways is of enough importance to warrant it a place in a nature-study program. The interest in good roads is steadily on the increase. There is little question that more time, energy and money have been expended in genuine effort to improve the roads of our State during the last ten years than ever before.

To arouse the interest of the entire community in a movement for good roads should be one purpose of these lessons. The first lesson may be a simple discussion of the roads in the neighborhood. How many roads in the district? What directions do they run? Are any of them crooked? How did the roads happen to be placed where they are now found? Tell the children to ask about this at home. Perhaps someone has a grandparent who can tell something about the laying out of roads years ago. In pioneer days of Illinois there were a few roads which connected one settlement with another; often these roads were mere trails across the prairie and through the woods. Have the children try to picture how the country looked in those days. In the woods there were roads winding among the trees. On the prairie there were great stretches of grass with a few scattered houses, often miles apart. There were no roads laid out as we find them now, but instead simple wagon tracks leading across the plains from one house to another.

Some of the old trails were kept as roads. This was especially true in the wooded tracts where the first trails were laid out along lines where there were the fewest difficulties to overcome. Most of our roads, however, have been placed by law. A certain number of feet around every section or half-section of land was reserved for roads. When a certain number of people petitioned to have the road put through it was made.

Have the children report upon the following: How far apart are the roads in the district? How wide are they? Are there ditches along the sides? What kind of fences along the roadside? Is there grass growing between the fences and the track? Are there any weeds? Any wild flowers?

KINDS OF ROADS.—Are the roads in the district all the same kind as to the material of which they are made? What are the different kinds of roads? We have earth roads, macadam, gravel, oil and in some places there are still a few old-fashioned plank and corduroy roads.

Earth roads are the most common in some parts of the State. However, people are becoming much interested in making hard roads, either macadam or gravel. In some places crude oil is coming into use. It is usually placed on a smooth gravel or sand foundation, but experiments are being tried to test its efficiency on a well-graded earth road. The value of oil, of course, is to make a road better able to shed rain.

MAKING ROADS.—Discuss with the children how roads are made. Every child should realize that certain fundamental points must be considered in building a road of any sort. One of these is the grade. Look at the roads near the school building. Are they

perfectly level from one side to another? Where are they highest? Where lowest? The rounded portion of a well-graded road is called the crown. If you should lay a board or measuring line from the crown of the road out to the edge of the ditch, holding it perfectly level, how many inches would it be above the upper edge of the ditch? How deep is the ditch? Then how many inches is it from the highest part of the road to the bottom of the ditch? Men who have made a careful study of road grades in Illinois tell us that the crown of the road should be about thirty inches above the bottom of the ditch.

DRAINAGE OF THE ROADS.—Another thing to consider in making a road is drainage. No road can be kept in good condition unless it is well drained. Grading and drainage go hand in hand. In most places the ditch along the side of the road carries off the water; in other places tile is used. Which is used in your district?

HARD ROADS.—If there are hard roads in the district, discuss how they are made. If some child has seen a hard road made, let him tell what was done and what material was used. A macadam road is made chiefly of crushed rock. It receives its name from a man named Macadam, who made the first roads of this kind in England a number of years ago. In making a macadam road, the first step is to grade, arrange for drainage, and shape the road. The next step is to spread the first course of stone. This stone should be crushed rather fine, about one and one-half inches in width. It should be spread about four inches thick. The third step is to spread the next layer of stone; this should be larger pieces of stone, about three inches in width, This should be spread six inches in thickness. After this has been done, the road is ready for the fine stone dust or screening. This fine material should be spread so that it will enter all the spaces among the broken stone. It is known as the binder, for it binds or cements the stones together, making an even, solid surface.

MAINTAINING GOOD ROADS.—How are the roads in your district cared for? Are there any officers whose business it is to see that the roads are kept up in good condition? In all of the counties that have township organizations, there are three road commissioners who have charge of all of the work, grading, rolling, dragging, etc.

The counties that have no township organization have county officers that look after the making of new roads and maintaining the old ones. Besides these local officers, there is a State Highway Commission. It is the duty of this commission to send speakers to meetings of various kinds in order to interest the people in the improvement of the roads, to give information along lines of road construction, to print bulletins and reports, showing what has been done in some places, and what may be accomplished by co-operation on the part of the people of any community.

ROAD TOOLS AND IMPLEMENTS.—What tools and implements are used in improving the roads in your district? Is there a grader in the district? A roller? A road drag? When is the work with the grader done? In many places the roads are graded in the late summer or early fall. This is not the best time; it should be done if possible in the spring. Do you see why? The purpose of using the grader is not merely to make the crown of the road higher, but to help the soil compact so that it will shed water. When a road is graded in the summer or fall the soil is usually so dry that a loose soil mulch is made that readily absorbs the rain instead of shedding it.

THE ROAD DRAG AND HOW TO USE IT.—Let someone describe a road drag and how it is used. The bulletin published by the Highway Commission in 1908 gives some excellent rules to follow in dragging a road. Some of them are as follows: The drag should be made light, not heavy. It should move slowly over the road, hence the team should be driven in a walk. The road should be dragged when it is muddy; never when it is dry. In the fall, if the road is dragged before a freeze, it will mean a good road most of the winter. Begin at one side of the road, returning on the opposite side. Drag a little earth toward the center of the road until it is raised ten or twelve inches. When roads are first dragged after a muddy spell, vehicles should, if possible, drive to one side, until the road has had a chance to dry out a little or freeze.

THE VALUE OF GOOD ROADS.—One or two lessons should be given to the discussion of the value of good roads. Have the children make a list of all the

benefits farmers derive from having good roads the year around. Do not let them stop with the mere advantages of being able to haul their produce to market, but talk also about the opportunity good roads afford for social intercourse and for intellectual advancement. They should see also that good roads are almost as great a benefit to the people of the towns and cities as they are to the country people.

DECEMBER

OUTLINE FOR DECEMBER.—*Some effects of heat upon bodies. Simple experiments to show effect of heating a solid, a liquid, a gas. Some practical application of expansion, of vaporization.*

How bodies are heated, simple experiment to show conduction, radiation, convection.

Heating systems of home, school, church, jacketed stove, hot air furnace, sky studies, movement of sun and moon.

The purpose of the nature study lessons this month is to interest the boys and girls in some of the physical phenomena that touch their lives upon every hand. At the same time the work will lead them to appreciate something of the wonderful laws and principles that we are constantly putting to the test every day in the home and school as well as in the shop on the farm.

A few simple pieces of apparatus are necessary for the work. Most of these may be furnished and arranged by the pupils themselves. Among other things mentioned in connection with the experiments a small alcohol lamp will be almost indispensable.

A simple lamp may be made as follows: Have a tinner make a tube about one and a half inches long and solder this into a cover that fits closely a vaseline or or other good size bottle. Procure some round wicking that fits the tube and your lamp is ready. Wood alcohol, which is less expensive than the grain alcohol, will serve the purpose equally well.

HEAT—ITS IMPORTANCE.—The first lesson may be an informal discussion of the importance of heat to us. Lead the children to talk about how dependent we are upon heat both that of the sun and artificial heat. Make the heating plant of the school room, whether a stove or furnace, the center around which to group the experiments and observations.

The first general problem is: How is our school room heated? First, examine the heating plant itself. If it is a stove find the essential parts and name them. These are the fire bowl, feed door, draft, pipe, check-draft, ash pan and a jacket if the stove is of the modern kind. The parts of a furnace are almost similar to those of the stove with the addition of the pipes and registers. While all of these parts are familiar to the children, the natural laws that have been considered in the making and setting up of a stove or furnace have probably never occurred to them.

Procure several small downy feathers. Hold one of these a short distance above the stove. Let it go and note what happens. Why does the feather move upward? Now hold the feather at the side of the stove and watch the movement. Place it near the draft in front of the feed door. If the room is heated by a furnace watch the movement of the feather when held near and above the register. The children may answer in part the question of what causes the movements. Tell them, however, that we shall try to answer the question more fully by some simple experiment.

Have some child bring a large iron nail or rod of iron. Measure the length of the nail or rod in the following manner: Lay the nail upon a piece of pine board and make a scratch in the board at each end of the nail. Heat the nail very hot by placing it on top of a glowing bed of coals in the stove. While still hot, try to place it between the scratches on the board. What effect has the heat had upon it? The children will readily see that it is a little longer than before it was heated. If they do not know the word "expand" this is a good time to give it to them.

Place the nail out of doors until it has cooled. Try again placing it between the scratches. What is the effect of cooling it? Have the children try to think of other solids that are affected by heat in the same way. Have them name some practicable applications of the fact that solids expand when heated and contract when cooled. (The placing of tires on a wheel, heating bolts and tightening burs as the bolts cool, heating the top of a fruit jar to remove lid.)

Let us try an experiment to see whether heat effects liquids as it does solids. Fill a tin cup level full of water, heat it slowly. What happens? Put a piece of

glass tubing about eight inches long through a rubber stopper, cork will serve equally well if it is not too porous. Fill a glass flask full of water, and put in the stopper. The water should now show in the tube just above the stopper. Slowly heat the flask. What indication have you that water expands when heated? When the water has risen almost to the top of the tube set the flask in a cool place. Does the water contract? Can you think of an important application of the fact that liquids expand when heated and contract when cooled?

THE THERMOMETER.—If you have a thermometer in the school room this is a good time to explain how it is possible to measure temperature by this simple instrument. What is in the tube of the thermometer? Is mercury a liquid or a solid? (Mercury is a very heavy liquid.) Place your finger upon the bulb of the thermometer. Why does the mercury rise in the tube? Why does the mercury go down when you place the thermometer out of doors on a cold day? The children will readily see that just as the water expanded with the heat the mercury expands and rises in the tube. It contracts with the cold. Because of this expansion and contraction, we may use it to measure temperature.

We have now found that heat expands both solids and liquids. Air is neither a solid nor a liquid, but is made up of several invisible gases. Let us try an experiment and see whether or not gases expand when heated. Use the same flask as in the preciding experiment. Pour out the water and dry the flask thoroughly. What is now in the flask? The children may not at first realize that the flask is not empty but full of air. Insert the stopper as before, but place over the end of the glass tube a rubber tube at least a foot long. Hold the end of the rubber tube under water. Now slowly heat the flask. What happens? (As you heat the air in the flask it expands and flows out through the rubber tube as indicated by the bubbles in the water.)

If the children are eager to know what happens when a body expands there is perhaps no better time to give them the simple fact that all bodies are made up of very small parts which are invisible even with the most powerful microscope. These are called molecules. When a body is heated the molecules probably move farther apart leaving spaces between them, thus the whole body occupies a larger space.

We are ready now to try another experiment with liquids and gases. Fill a tumbler two-thirds full of very cold water. Heat some water almost to the boiling point and color it with a few drops of red or black ink. Make a paper tube about an inch in diameter by rolling up a sheet of paper. Hold this tube in the middle of the glass of cold water with the end on the bottom of the glass. Now pour some of the warm colored water into the tube. Watch it as it begins to come out at the bottom. Slowly lift the tube. Why does the colored water come to the top of the glass? The teacher can perhaps lead the children to see why, by asking them another question. Why does a piece of cork come to the top of a glass of water? Which is heavier, the cork or the water? In the same way that cork floats upon water, the warm water floats on the top of cold water. Or we may say that the cold water holds up or even pushes up the lighter water. We shall try another experiment to show this more clearly.

Fill the flask about half full of water. Place a little chalk dust in the water. Hold the flask so that it is heated more at one side than at the other. Now watch carefully for movements of the water. If the experiment works properly the children will be able to see a current of water moving in the flask. The water that is first heated near the bottom of the flask expands and becomes lighter. The colder water rushes in and pushes the lighter water upward. This movement of the water caused by the heat is called a convection current.

Light an ordinary kerosene lamp. Hold a smoking match or splinter below the burner at one side. What happens? Why does the smoke move inward toward the burner? Hold a feather or bit of paper above the lamp chimney. What is the movement at this point? This simply shows the convection currents of air around a burning lamp. Have the children explain the movements of the air. (The air within the chimney becomes heated and expands. It is lighter than the air on the outside. Hence the cold air rushes in and forces the warm light air upward.)

We are now ready to return to our question concerning the stove or furnace. It may be well at this point to repeat the experiment with the feathers. Why does the air move upward above the stove? By means of feathers or a burning candle trace convection currents in different parts of the school room. What makes the air

that is in the jacket around a furnace come up into the room through the register? The children will readily see that the fresh air coming in below pushes the light warm air upward through the pipes into the room.

A JACKETED STOVE.—If the stove is jacketed have the children trace the air by means of light feathers on the end of a stick from the jackets to various parts of the room and back toward the stove or duct for the exit of impure air.

Why is the jacket stove in one corner of the room better than an unjacketed one standing in the middle of the room? This question, too, we must answer by means of experiments. Place an iron poker in the stove and heat the end of it very hot. Take it out and hold your hand a short distance above the heated end. Can you feel heat coming from it? Hold your hand at the sides and below. Can you feel the heat coming from it at all directions? This kind of heat is known as radiant heat. It is the heat that streams in straight lines from any heated body. It does not need air to travel through. It is the kind of heat that we get from the sun. Hold your hand near the stove on every side. Is the stove radiating heat? If you place a chair near a stove after a time it becomes hot. How was it heated? (It was heated chiefly by radiant heat from the stove.) Where shall we place objects with reference to the stove in order that they may receive the greatest amount of radiant heat? What part of the school room will be kept hottest by an unjacketed stove? What will be true of the parts of the room that are at some distance from the stove? When you put a jacket around the stove, what is most of the radiant heat from the stove doing? (It is heating the air that is confined between the stove and the jacket. From our study of convection currents we know that the heated air is carried to all parts of the room so the school room is heated equally in all parts.)

All the facts that have been brought out in connection with the jacketed stove apply also to the hot air furnace. The only difference is that in connection with the furnace there are pipes to convey the heated air into the room.

Can you think of something else that we should consider in connection with the stove and the furnace in heating a room? Is there any way provided by which fresh air may enter the jacket of the stove or furnace? Why is it important that the air in the jacket be kept pure? Since this is the air that is carried to all parts of the room, it is the air that we must breathe. If this is kept pure then the ventilation of the room will always be good.

There is still something else that we need to know about the hearing of bodies. Put the end of an iron poker into the bed of burning coals or hold the end of a nail in the flame of an alcohol lamp. Allow it to remain several minutes. Is it hot at any point except where it is surrounded by the fire? How far from this point can you detect heat by touching it? What then must have taken place in the piece of iron? (The heat must have traveled slowly from the part that was in the fire to the other parts. When heat travels from one particle of a body to another in this way we say that the body is heated by conduction.) How is a flat iron heated? The handle of a frying pan or stew pan?

It will be interesting to make a test of the conductive power of different kinds of material. Place a small stick of wood in the fire just as you did the poker. What happens? How far from the end of the stick can you detect heat? Which is the better conductor of heat, iron or wood? Why are wooden handles placed on iron and steel cooking utensils? Place your hand on the window pane, then on the wood of the window sash. Which feels colder? Since the glass and the wood are side by side they are at the same temperature. The glass feels colder because it conducts heat from your hand so rapidly. Why are woolen clothes warmer than cotton? (They are warmer because they are poor conductors of heat and hence keep in the heat of the body.) Make a list of good conductors of heat and poor conductors. Many solids are good conductors of heat but liquids and gases are very poor conductors. Air is one of the poorest conductors known. It is the air among the hairs that makes a fur coat or collar so warm.

Is conduction used in any way in the heating of the school room? How is the stove itself heated? The children will have no difficulty in seeing that the iron which is contact with the heated fuel is heated largely by conduction. Have the children summarize all the points in the heating of a room by a stove or by a furnace. This may be put in a form of a story and used as a composition in correlation with the grammar.

Spend two or three lessons in discussing how the various homes of the children are heated and ventilated. Encourage the children to try simple experiments in de-

tecting convection currents about the home and in finding examples of radiation and conduction. Discuss also how the churches and other buildings of the community are heated and ventilated.

It will perhaps be worth while, if time permits, to study the effect of heat in changing substances from one state into another. Procure a cake of paraffin, tallow will serve as well. This is in what form, liquid, or gas? How may we change it into a liquid? Place a part of it in a cup or pan and heat until it becomes a liquid. Put a portion not more than a teaspoonful on some live coals. What happens? A black smoke arises. This is the paraffin changed into vapor. We see then, that heat changes the solid paraffin first into a liquid and if more heat is applied into a gas or vapor. Show by a simple experiment that water may be changed into vapor by heat.

What happens when a liquid changes back into a solid? To answer this, fill a cup level full of melted paraffin and set in a cool place until the next day. What has happened? (The paraffin contracts or shrinks as it cools which accounts for the sunken place in the top of the paraffin.) Most other substances act the same, that is, they contract as they solidify. While this is true of most substances there is one important exception and that is water. If the weather is freezing cold, fill a tin cup level full of water, set it in a saucer or pan and place out of doors. Bring in the next morning. Did the water contract or expand as it cooled and solidified? (It is very easy to see that the water expanded.) Have the children give some examples to show that water expands when freezing. (The breaking of a pitcher or glass.) Which is heavier ice or water? To answer this put a piece of ice into a cup of water. Does it sink or float? Since ice is lighter than water this is another evidence that it expands as it solidifies.

The last experiment showed us that water expands when it freezes. One of our first experiments showed that water expanded when heated. Since this is true there must be a certain temperature at which water reaches its greatest weight or density. This temperature is 39.2° Fahrenheit. If we heat water above 39.2° it expands. If it is cooled below this temperature it expands also. If you have a cupful of water whose temperature was 80° Fahrenheit and you heat it will it expand or contract? (It will expand until it reach the boiling point.) What if you should cool the same cupful of water? Would it contract or expand? (It would contract until it reached 39.2° when it would begin to expand and continue to expand until frozen.)

Summarize all the effects of heat upon bodies giving illustrations of each. If time permits give one lesson to the discussion of how the earth and air are heated. The earth absorbs the radiant heat from the sun. The hotter the day the more heat is absorbed. At night the earth radiates some of its heat, the heat goes into the air. The air receives more heat from the radiation of the heat from the earth than it does from the direct rays of the sun.

SKY STUDIES.—Of all the objects in nature none are so constant as the sun, moon and the stars. With a little direction children may be led to recognize a few stars and constellations as well as the movements and phases of the moon. Perhaps no other field of observation will yield greater returns in pleasure and satisfaction to the children, not only while they are in school but when they have grown to manhood and womanhood.

Keep a simple record of the time of sunrise, sunset, the position of the sun in the morning, at noon, in the evening. Are there any changes in position? This work will mean more to the children if it can be continued for several months. A few minutes may be taken for reports, one in two weeks.

Have children observe the moon during an entire month. Begin with the new moon. Have them keep a simple record of its position in the sky, the time of day observed, and its shape. At the time when the moon is about full and for two or three days afterwards, keep a record of the time that it rises. At the end of the month, spend one or two lessons comparing the records of the children and getting the facts concerning the different phases of the moon. An almanac will be helpful here.

For a study of the stars, the Big Dipper makes a good starting point. Have the children find the Big Dipper. Where is it? In the North, East, South or West? Count the number of stars in it. How many in the bowl? How many in the handle? Is the handle straight or crooked? By means of the dipper the children may be directed how to find the North Star. To do this tell the children to find the two outside stars in the bowl. If they could draw a line straight out from the upper

star and in line with these two, it would touch a rather pale, bright star, which is the North Star. This is also called the pole star. Watch the dipper a number of nights to discover whether it is always in the same position with reference to the North Star. Look at it at different times the same night, early in the evening and just before going to bed. What is your conclusion as to whether the dipper moves around the pole star? (The dipper apparently moves around the North Star once every twenty-four hours.)

See if you can find a smaller dipper nearer the north pole. The bowl is almost a rectangle like the side of a box. The handle has three stars but the third star and the end of the handle is the North Star itself. Watch for movements of this as you did of the Big Dipper.

Another interesting group of stars that is easily found during the winter months is Orion. This is found toward the southern half of the heaven at this time of year. There are three bright stars in a row. These three stars are known as Orion's belt. Grouped around the belt are four other large stars and near the belt a line of rather small stars ascending downward. Another constellation is the small group of stars very close together and which seem to have a mist around them. This is known as the Pleiades. How many stars can you find in the group? Six are plainly seen. There are, however, about three thousand in it that we can not see.

Starland by Ball, or the Storyland of Stars by Pratt are helpful books for this study.

JANUARY

OUTLINE FOR JANUARY.—*Begin weather record, noting wind direction, cloudiness, temperature, rainfall. Effect of weather upon plants, upon winter wheat, upon animals. Work of the Weather Bureau.*

Composition of air; oxygen, nitrogen, carbon-dioxide, water-vapor. Demonstrations by teachers. Ventilation of home, school, church.

The common lift or suction pump; study of pressure in liquids and gases, developing interpretation of pump and barometer, and constructing each, using gas tubing or lamp chimney with cork and leather valve. The force pump. Interpretation of the weather map.

LESSON PLANS.—Weather. Keep the weather record and note the effects of weather on life as suggested for the sixth grade in December. Send to the Weather Bureau Station at Springfield and ask to have the daily weather map sent to your address. Preserve the maps for study later in the month. Look up, in the geography or some other source, the history and work of the Weather Bureau.

Toward the end of the month have the pupils make a short summary based upon their observations. How many fair days their weather record show? How many cloudy? How many in which there was precipitation? What was the general direction of the wind for the month? What was the direction of the wind when the temperature was lowest? When the temperature was highest? From what direction did the rain or snow come? What was the direction of the wind during the cloudy weather?

Study the weather maps. Point all the different things that you find on one map. Read the explanatory note in the corner. Do you find the words high and low? What do they mean? A low means a region in which the air pressure is light or in which the barometer stands low. High means a region of high pressure. Look at the arrows in the vicinity of low. Are most of them moving towards the center of the low, or away from the center? Note the same things in connection with the high. Does this agree with what we have already learned about the movement of air currents?

The lows are sometimes called cyclones, because the great mass of air is moving in a circle toward the center of the low. (This does not mean the same as the term cyclone that we use to indicate a tornado or storm.) The low usually starts in the west and moves across the United States in a general easterly direction. Whenever a low approaches we are liable to have cloudy, rainy weather. When a high is passing over we have fair weather. These lows and highs are constantly passing. Find the lows and highs on the maps for the entire month. See if you can discover about how far a low travels from one day to the next.

Spend at least one lesson discussing the weather bureau and its work. The headquarters of the weather bureau are at Washington, D. C. There are stations situated

all over the United States. At each station reports of temperature, wind, etc., are sent by telegram to headquarters. From here the data are sent to every station that prints a weather map. An expert there interprets the data, makes predictions for the weather, all of which are printed on the map. Besides the daily weather map the bureau often sends out special reports of severe storms that may be approaching.

The good the weather bureau does is hard to estimate. Seamen, fruit growers and farmers are all learning to depend upon the predictions and to make preparations for approaching storms or cold waves.

It will be worth while to continue the observation of the weather and especially of the weather map for the rest of the winter. Some pupil may be appointed to see that the new weather map is put up each day where everyone may see it. A few minutes spent occasionally in having pupils report weather conditions or to predict weather conditions from the weather map and their own observations will be quite worth while.

AIR.—The study of the wind will afford an excellent opportunity to apply some of the physical principles studied last month. What is wind? Why does the air move? The answer to this takes us at once to convection currents. The children found that currents of air in the room were due to the fact that some portions of the air were lighter and were pushed upward by the heavier cold air. Lead them to picture what is happening out of doors. Some portions of the air become lighter than other portions and the heavier air moves toward the light, causing a breeze or wind. What causes some portions of air to be lighter than other portions? The children have already learned that when air is heated it expands and becomes lighter. In order that they may think out whether or not there are other causes that make air light they will need to know something about the air itself.

What is air? It is composed of a number of invisible gases. The gas that forms the greatest amount of the air is nitrogen. It constitutes almost the three-fourths of the air volume. The most important gas is oxygen. This constitutes almost one-fourth. The other two gases that we should remember are carbon-dioxide and water vapor. Each of these constitutes a very small portion of the air.

Discuss the characteristics of air. It has at least two qualities that are of great importance. One is weight, the other pressure. Have the children try to think out some way to prove that air has weight. While air is not very heavy, yet if you had a pair of balances and should weigh a large bottle that is full of air then remove the air from the bottle by means of an air pump you would find that the bottle is quite a little lighter than before.

We can show that the air has pressure by some simple experiments. Fill a tumbler full of water, hold your hand over the mouth and quickly invert it into a pan of water. Hold it so that the mouth is just below the surface of the water in the pan. Try the same experiment with the tallest bottle you can find. What holds the water up in the glass and bottle? It is the pressure of the air upon the surface of the water in the pan. The air is pushing downward upon the water with great enough force to hold the water in the glass. The pressure is due to weight. How far up does the air extend that is pushing downward upon the pan of water? (As far as the air extends outward from the earth which is somewhere between 50 and 100 miles.) You can think then of a great column of air extending upward from the pan of water. What part of the column will exert the greatest pressure? To answer this think of a great pile of books on top of each other. The lower one will have the weight of all the others pressing down upon it. The same thing is true in the column of air. The pressure is greater at the lowest part because of the weight of all the air above it. Where is there greater air pressure, on a mountain top or in a valley? Why?

Do you think we could find a tube so long that the air pressure could not hold the water to the top of it as it does in the glass and the bottle? We can not answer this by experiment for it would take a tube much too long to make the test. We can try it, however, in another way. Instead of using water we can use another liquid, mercury, which is about thirteen and a half times as heavy as water. For this experiment you will need a glass tube at least thirty inches long and closed at one end. The tube should have a very small diameter. Fill the tube full of mercury. (An easy way to do this is to make a small funnel out of paper to insert in the mouth of the tube.) Invert the tube into a dish of mercury just as you did the bottle in the pan of water. What happens? Why did some of the mercury flow out? Why did it stop after a certain portion had flowed out? The pressure of

the air was not sufficient to hold up all the mercury so the mercury flowed out until the air pressure was great enough to hold up the column that was left. (This point should not be left until the children can see clearly that the mercury column in the tube is held up or balanced by a column of air of the same diameter but reaching upward as far as the air goes. The children may see this more clearly by comparing the mercury and the air to a pair of balances, one arm equals the other in weight.)

If something should cause the air to become lighter would the mercury go up or down? What would be the effect on the mercury if the air should become heavier? Measure by means of a yard ruler the exact height of the mercury. Leave the apparatus standing for a number of days and with the ruler measure the height each day. Does the mercury column vary? If it does then the air pressure must vary also and you are able to measure this variation of the air column by means of the mercury column. You have really made a simple barometer. A barometer is an instrument used to measure air pressure.

Why does the pressure of the air vary from day to day? The children will be able to give one reason. They know that warm air expands and hence is lighter than cold air so the temperature may effect the air pressure. There is something else, however, that for some reasons is even more important than temperature. When air has a great amount of water vapor in it it is lighter than when it is chiefly made up of oxygen and nitrogen. This is true because water vapor is lighter than either of these gases. Think of some examples that illustrate this fact. You have noticed that sometimes the smoke from a chimney drops to the ground. Why does it do this? It is heavier than the air, hence the air can not float it upward as it usually does. This indicates a considerable amount of water vapor in the air.

When there is a great deal of water vapor in the air will a barometer stand low or high? If what we have said above is true, then the mercury will not be as high because the air is not heavy enough to hold it up. Will a low or high barometer then indicate the approach of stormy weather? (A low barometer indicates approaching stormy or rainy weather, while a high barometer indicates fair weather.)

Pumps.—We may begin the study of pumps with a simple experiment. Place the end of an open glass tube in a tumbler of water. Slowly suck the air from the tube. What happens? Why does the water rise in the tube? (You have removed the air from the tube and the pressure of the air upon the water in the tumbler pushes the water up into the tube.) This illustrates in a simple way what happens when you pump water with an ordinary suction pump. This may be shown better by a simple piece of apparatus. The children should be given an opportunity to try their skill in making a simple piece of apparatus to illustrate the working of the pump. Procure a straight lamp chimney, two pieces of cork, a glass tube, some pieces of thin leather and some wire. Make a hole in one piece of a cork and fit the piece of glass tubing into this hole so that the tubing will come just to the surface of the cork. Over the hole place a thin piece of leather, fasten it at one end with a small tack or pin. This cork should fit closely into the lower end of the chimney. Make a similar hole in the end of the second cork and fasten a piece of leather in the same way over the opening. Fasten a piece of wire into the cork so that it will make a curve at least an inch above the cork. To this wire fasten another heavier wire. This cork should be trimmed off so that it will move easily up and down in the chimney. You now have all the parts of a simple suction pump. The chimney is the pump barrel or cylinder. The cork that moves up and down is the piston and the wire with which you move it is the piston rod. The bits of leather covering the openings are valves.

Place the glass tube of the pump into a dish of water. Pull the piston upward. What happens? Now move the piston downward and watch. What effect did the lifting of the piston in the first place have upon the air in the cylinder? A portion of the air was lifted up with the cylinder, hence the air pressure upon the water in the pan was greater than that in the cylinder and pushed the water upward through the lower valve. Have the children watch carefully so that they may tell everything that happens when you move the piston downward. Why does the water move upward through the upper valve and why does the lower valve remain closed? The pressure now is due to the force with which you are pushing the piston downward. This force of the water pushes upon the lower valve and holds it down, but the same force causes the water to push against the lower part of the piston which opens the upper valve and gives the water a chance to rush through. This is exactly what happens when we pump water from a well.

Spend a short time helping the children to see that the pressure of the air in the case of the pump is really doing some work, that is, it is exerting energy. Have them think of some other ways in which the air does work or exerts energy. (The wind mill, sail boats, the energy exerted in the time of storms when buildings and trees are overturned.)

FEBRUARY

OUTLINE FOR FEBRUARY.—*Poultry raising; breeds of chickens of the neighborhood; characteristics of each; feeding, housing, general care. Incubators and brooders; expenses, profits, other kinds of barnyard fowls; value and peculiarities of each. Scrapbook.*

Where fruit trees were studied in the fall take up the study of propagation by grafting. Why necessary? History. History of an apple tree from seed to maturity. Make grafts. Spraying, pruning, planting.

POULTRY.—There are few schools in Illinois either in town or country in which lessons on poultry may not be of value.

The first lesson may well be devoted to a discussion of some of the things that the children already know about poultry. What different kinds of poultry are raised in the district? What different breeds of chickens? How many people keep just one breed? Who keeps a mixture of several breeds?

Follow this with a study of the characteristics of chickens. Give the children a number of points to discover by actual observation at home. How many different kinds of feathers can you find on a hen? How do the feathers overlap? Do they differ in this respect on different parts of the body? How do the feathers of the cocks differ from those of the hens?

ORGANS OF LOCOMOTION.—Note the feet of the chickens. Are they placed near the front or back part of the body? How many toes are there? Are they the same length? What is found at the end of each toe? Do the hens walk on their toes or on the sole of the foot? (Chickens and all birds walk on tiptoe. The segment that we often call the lower part of the leg is really the foot. The foot ends at the first joint.) Has the foot any protective covering? Why are scales a better covering for the feet and toes than feathers? Do you find any chickens that have feathers on their feet? Try to find out how chickens hold their toes on the perch at night. (The toes curve around the perch and the chickens rest upon its feet in such a way that the weight of the body helps to hold it fast to the perch.)

What other organs of locomotion do chickens have besides the feet? To what do the wings in chickens correspond in other animals? (They correspond to the fore legs in mammals and to the arms of people. If you look at the bones of a chicken's wing you will find that they correspond to your own upper and lower arm. You can even find some of the small bones of the wrist and hand.)

PROCURING FOOD.—What is the chief organ the hens uses in procuring her food? Is the beak or bill well adapted for its purpose? Is it hard or soft; sharp or blunt? Does it differ at all in different breeds of chickens? Name the different kinds of food you have seen hens eating, and the different ways using the beak. Do you know how a hen cleans her bill? (You will find her stroking it on a board or some other hard substance.) Has the hen any teeth? (You can not find the answer to this question by observation so you must take it on authority. Hens have no teeth. They sometimes use the bill to break up particles of food, but they do not chew food at all. You probably know that the food is ground up by small pebbles and other hard particles in the gizzard.)

Is the bill of any other use to the hen than to obtain food? (It is used as a weapon of defense, to clean and oil the feathers, and to turn the eggs during incubation.)

SENSE ORGANS.—Name all the sense organs you can find on the head of a chicken. Note the position, shape, and color of the eyes. Can the hen see the same object with both eyes at the same time? Are there any eyelids present? If you watch a chicken closely you will find that the lower lid moves upward and closes the eye. There is another lid which is a thin membrane that spreads over the eye like a veil. This is found in all birds and is used as a protection to the eye.

Where are the ears situated? You will find the ears as small, irregular open-

ings on the sides of the head. Usually they are covered with feathers. Although the external ear is so inconspicuous the hen can hear exceedingly well.)

Note the position of the nostrils. (These are the small openings on the upper part of the bill. The sense of smell is probably not very keen in hens.)

FEATHERS.—Spend at least one or two lessons in a detailed study of feathers. Tell the children to bring as many different kinds of feathers as they can find. Each child should have the following: A feather from the tail, one from the back, breast, neck, legs, and one from each of the different parts of the wing. (These will include the stiff outer wing feathers, the primaries; the row of large feathers next to these, the secondaries; and the finer, overlapping feathers, the coverts.

The main tail feather is a good one from which to get the names of the different parts. The central hard portion of the feather is called the shaft. Some people call it the quill. The soft portions that grow out from the shaft are the barbs. Are the barbs joined together in the tail feather? The portion near the end where they are joined closely is called the web. The loose portion of the barbs near the lower part of the shaft is called the fluff. Compare the different feathers as to the amount of web and fluff. Which has more fluff, the feathers of the back or breast? Which of all the feathers have the least fluff? Which the greatest amount? What part of each feather is exposed to the weather? (Only the web is exposed.) Look closely to see how much of each web is exposed. Can you think of the value of this great overlapping of the feathers? (Its special use is to protect the body from rain. It is, of course, only the web that does this.) What is the use of the under-coat of fluff? Place the tips of your fingers close to the body in the fluffy part of the feathers. Now place them on the outer part of the web. Can you detect any difference in the temperature? Recall what you learned last month about conductors and non-conductors of heat and decide in which class feathers belong. (It is easy to see that feathers are non-conductors of heat and that the use of the fluffy portions is to keep the chicken warm by preventing the radiation of heat from the body.)

How does the hen succeed in keeping her feathers smooth and in condition to shed water. She does this by frequently oiling them. If you watch closely you may see just how she does this. She has a small oil gland situated on the back just in front of the tail. She obtains the oil by pressing the gland with her beak, then she rubs it on the feathers, especially on those of the back and breast.

It is worth while at this point in the study to call attention to the fact that all of the characteristics named above belong not alone to chickens but to all birds. Have the children make a summary of these characteristics.

BREEDS OF CHICKENS.—If there are representatives of different breeds of chickens in the neighborhood, a visit to these for the purpose of studying their characteristics will be greatly worth while. Pictures of the different breeds will also help. The children should be encouraged to make a chart showing pictures of different kinds. These may be obtained from poultry journals and farm papers.

Poultry raisers group the breeds into four great classes: Egg breeds, meat breeds, general purpose, and fancy breeds.

Egg breeds were originally European birds and hence are known as the Mediterranean class. They are small, active chickens. The hens are noted for the great numbers of eggs that they lay and for the fact that they rarely want "to sit." The most common varieties are Leghorns, Minorca and Black Spanish. These breeds are not widely raised in Illinois but they are becoming more and more abundant.

The meat breeds are known as the Asiatic class, because the original stock probably came from Asia. There are two common varieties, the Brahma and Cochin. They are very large, heavy bodied chickens and produce a large amount of meat. They are not good layers and are of little value in raising chicks.

The general-purpose breeds are more popular than any other in our state. They belong to the American class, because they have been produced by American breeders. They are medium in size and are comparatively good layers, hence they are useful in producing both meat and eggs. They are also better adapted than the other breeds to raise and care for the young. The common varieties are the Plymouth Rocks, Wyandotte, and Rhode Island Reds.

The children should compare the different breeds with each other as to size, color, shape and value. The fourth breed named above is of little practical value. Occasionally some one raises bantams or other fancy breeds just for the novelty of it.

CARE OF POULTRY.—Make a list of items you would consider in caring for poultry. (Housing, feeding, care of young.) Have the children tell the different methods of housing used in the neighborhood. Follow this with a discussion of the points that should be observed in making a poultry house. One of the first things to consider is how to get plenty of sunlight into the house. Let the children tell how they would manage this. The best plan is to have the building face the south with a number of windows. The windows should be high enough to admit sunlight to all parts of the building. In the second place, the floor should by dry. That means that the building should be placed on well drained ground. Some poultrymen elevate the floor several inches with a layer of gravel. On top of this is a cement floor. A cement floor is considered very good. It is quite inexpensive since it is not necessary to make it very thick. Another advantage of this floor is that rats are not so likely to get into the house.

The third important consideration is ventilation. A way must be provided for exchange of air. Some poultry houses are so open that there are too many drafts. Many plans have been tried for securing ventilation without drafts. Probably the best method yet found is the cloth window. This may be made of muslin or cheese cloth and may be placed in one of the south windows instead of glass.

Discuss next, the purpose of the poultry house. (It serves two main purposes—a place for roosting and for nests.) Discuss different kinds of perches. Let the children describe those they know and decide which are most economical and convenient. The most important point is to have the perches so placed in relation to the nests that the latter will be kept perfectly clean. Perhaps the most practical method used is to place the nests under the perches with a platform between. In this way the same floor space is used for perches and nests. Many poultry raisers prefer to have both platform and perches movable, so that they may be taken out, cleaned and disinfected.

Have the children discuss how nests are made, the material used, and the size. (A nest should be from ten to twelve inches square and from six to eight inches deep.)

FEEDING.—Let the children make a list of the different kinds of poultry foods used in the district. What grains are fed? Are they fed dry or moist? Whole or ground? Chickens, like all other animals, need a certain amount of starchy foods or carbohydrates, proteids, and fats. Laying hens require a large amount of proteid food because the white of egg is almost pure proteid. Every poultryman decides for himself the exact amount of the different kinds of feed. All feed grain, of some kind, part whole and part ground. The whole grains should be scattered in straw on the ground or floor so that the chickens will be compelled to exercise in order to get them. Meat scraps and sour milk supply the proteid. Green food of some sort seems to be quite essential. This may be supplied by vegetables, such as cabbage, beets, turnips, etc., and by clover, alfalfa and sprouted oats. Chickens require plenty of fresh, clean water as well as food. The drinking pan should be emptied and fresh water put in every day.

CHICKS—Discuss the methods that are used in the district in raising chicks. How early in the spring do people begin to set the hens? Who has an incubator? If any of the children have one at home it should be carefully described. How warm must the incubator be kept? (It must be kept at a temperature of about 102° F. The heat is usually supplied by a small oil or gas heater.) When the chicks are taken from the incubator how are they kept warm? Different methods are employed for this but usually they are placed in a brooder which is a small box with strips of cloth among which the chicks may cuddle down to keep warm. Let the children tell how the food of young chicks differs from that of grown up chickens.

VALUE OF POULTRY.—Spend one lesson discussing the value of poultry. Name all the different products produced. (Eggs, meat, feathers.) How important are these products? They are becoming more and more important each year. The demand for choice chickens and fresh eggs is constantly on the increase and the prices are high enough to make poultry raising a very successful business. When are eggs the highest price? Encourage the children to try some systematic plan of feeding chickens during the cold months and note the effect upon the yield of eggs.

A chicken raising contest would be an excellent thing to start in many districts. Encourage the children to raise chickens on their own account. Help them to look up plans and methods in farm papers and magazines. If a contest is anticipated, a

simple record should be kept by each pupil as follows: (1) The number and market value of chickens he has to start with; (2) the cost of food and all other necessary equipment; (3) the number of eggs obtained and value at the market price; (4) number of chicks raised and value at market price; (5) approximate amount of time spent in caring for the chicks; (6) net gain or loss for the year; (7) notes of value, that is, things that are worth remembering for future use.

If time permits a comparative study of other kinds of poultry will be worth while. The special adaptations of bill, feet and feathers of ducks and geese should be noted.

GOVERNMENT POULTRY BULLETINS.—The following farmers' bulletins, which may be obtained free from the Department of Agriculture, Washington, D. C., will be found helpful: No. 287, Poultry Management; No. 64, Geese and Ducks; No. 51, Standard Varieties of Chickens; No. 236, Incubators; No. 200, Turkeys; No. 225, Poultry House Construction.

PROPAGATION OF APPLE TREES.—The first lesson on the apple tree should be a brief review of the work done last October. Have the children recall the different varieties of apples studied, parts of an apple, and the care and marketing of apples. The chief question left over at that time was how apple trees are propagated.

How an apple tree is produced is a most interesting story. If the story can be illustrated by actual observation and handwork it will be of great value to the children. The very best way to bring this about, if there is a nursery in the district, is to make a visit to the nursery grounds and observe what is actually being done. If one of the men could be induced to come to the school room and give a practical demonstration of the making of grafts it would mean much to the children. This should be followed by having the children make grafts of their own.

Why is it necessary to graft apple trees? To answer this question we must know the entire story of the "making of an apple tree."

If you wish to produce a Jonathan apple tree, how would you proceed? If you planted seeds from a Jonathan apple and let the tree stand until it was old enough to bear, would it give you Jonathan apples? It probably would not, in fact the apples might be not at all like Jonathan apples. They would probably be small and sour. The same would be true of any other variety of apple raised from seed. We cannot depend upon the seeds to produce a desired variety. That is because, as nurserymen say, apples do not come true to seed. But while we do not raise our apple trees from seeds, we begin with the seeds after all. The seeds are planted in the fall or very early in the spring in long drills. These grow and produce small seedling trees the first year. Any apple seeds will do for these seedlings, but many nurserymen use the seeds of a hardy wild apple that grows on the hillsides of France.

The seedlings are removed from the ground in the fall, tied up in bunches of from fifty to one hundred each, and placed in moist sand or moss in cool cellars. During the winter months, usually in January and February, these are grafted. If you wish to produce a Jonathan apple tree you will choose a twig from a Jonathan tree. This twig we call the scion. You will get one of the seedlings which was placed in the cellar, cut off the seedling stem from the root and on this root, which is called the stock, you will graft the Jonathan scion. This is done by making a diagonal cut on both stock and scion, then making a slit on the cut surface of each and slipping them together. This is the first step. The next step is to wrap grafting thread around the graft to help hold the scion and the stock together. When you have made a number of grafts tie them together and place them in a cool cellar. Leave them until the soil is in good condition to work in the spring, and then set them out in a row nine or ten inches apart, and deep enough so that two or three inches of the scion will be above the ground. The scion grows fast to the stock and then grows upward producing the little apple tree, while the root is all that is left of the seedling. Nurserymen leave the trees from two to three years in the nursery row, then they are ready to be removed and set out in the orchard. Do you know how long it will be after the tree is set out in the orchard before it will produce apples? (Different kinds of apples vary in this respect. Some produce apples in six or eight years, others require ten to twelve years.) You see, then, that to make an apple tree, beginning with the seed, requires one year before it is ready to graft, two or three years in the nursery row and from six to ten years in the orchard before it bears fruit.

How long do you expect an apple tree to bear fruit after it once begins? You may perhaps have visited at your grandparents where there is an orchard still bearing fruit that was set out when your grandfather was a young man. Apple trees, if well taken care of, will bear from twenty to fifty years.

MARCH

OUTLINE FOR MARCH.—*Continue corn study. Germination tests. Planting experiments of corn.*

Varieties are "adapted" to different regions. Competitive corn growing with selected and tested seed.

Continue wheat study in locality where this was made the special fall study. Conditions of plants; "stooling out" habit. Number of stems from one root.

Simple treatment of plant breeding based upon corn and wheat studies. Develop idea of improvement of plants by variation, selection, heredity, adaptation. Struggle for existence and survival of fittest in wild forms.

CORN

STUDY OF THE KERNEL.—While it is still almost two months until corn planting time, nevertheless, it is not too early to begin planning for the corn crop. In fact, there is one very good reason for beginning at once, and that is to determine whether or not the seed is in perfect condition.

One lesson should be spent in discussing how the seed corn of the neighborhood has been kept during the winter. Each pupil should tell exactly what method has been employed in his home. The advantages and disadvantages of the various methods should be considered. This will afford an opportunity to review the October work, especially the part that pertained to selecting and storing seed.

How can we know whether the seed is all right, that is, whether all the grains will germinate and grow? There is but one way and that is to make a germination test. Before starting the test it will be quite worth while to find all you can about a kernel of corn. Soak a number of kernels over night. For study each pupil should have at least two soaked grains and one dry one. Compare the dry and soaked specimens, noting the changes that have taken place.

Carefully remove the covering from a soaked grain. Looking at the flat side decide how many distinct parts there are. The oval shaped portion which is a dirty white color in the *embryo*. Sometimes we call this the *germ*. With a penknife remove the entire embryo using care not to tear it. Lay the rest of the grain aside and examine the embryo. On the upper side you will find an indistinct slit. Pull it gently apart lengthwise at this place and you will find within a rod-like body slightly pointed at each end. This is the tiny plantlet. The end toward the crown of the grain is called the *plumule*. The other end is the *hypocotyl*. Which end will make the shoot and which the root? To answer this question try the following experiment:

Place several soaked grains on a piece of moist blotting paper. Turn a tumbler or cup over them in order to retain the moisture. A moist piece of cloth will serve as well as plotting paper. Keep in a warm place. Examine after three or four days and the corn will answer the question.

Examine the portion of the grain that was laid aside. This is called the *endosperm*. How does the endosperm compare in amount with the embryo? Cut it in two across the grain. Does it seem to be made of the same kind of material throughout? The granular portion toward the upper part is almost pure starch. Do you find any of this starch toward the tip of the grain? The hard, solid looking material, at the sides is known as horny starch.

Pupils of the Seventh and Eighth grade will probably know that the function of the endosperm is to furnish food for the growing plant. To what extent is the plant dependent upon this food supply? To answer this carefully remove the embryo from a number of seeds. Plant these embryos in soil in a flower pot or can. Place in a warm temperature and keep watered. In another pot plant the same number of whole grains. Let them stand for several weeks and decide how great the value of the endosperm is.

GERMINATION TEST.—Different people use different methods for testing the vitality of corn seed. The methods matter little. The following is a good one:

Procure a shallow box three or four inches deep. The boys may make one. Place about two inches of clean, moist sand in the bottom. Soil will do equally well if sand is hard to procure. With a piece of board make the surface very smooth. With a sharp stick or the end of a ruler, divide the surface into squares two and a half or three inches each way. Place the number 1 at one corner of the box. Count the number of squares on one side. Now begin the second row, placing the number of the first square of the second row below number 1, for example, if there are seven squares and number 1 is at the upper left hand corner, number 8 is just below. Number 15 is just below number 8. All of the other numbers may be easily determined.

The next step is to get the corn ready for the box. Have the children bring seed corn from home. If several boxes are used this will afford an opportunity to test the advantages of different methods of storing the seed. Six grains from each ear should be tested. Two should be taken from the ear near the butt, two from the middle, and two toward the tip, but no two from the same row. Place the six grains on square number 1 in the box with the germ side up. Press them slightly into the sand. Now number the ear 1. This may be done by sharpening a small piece of shingle, putting the number on it and sticking it in the pith at the butt of the ear. Remove six grains from another ear in the same way and continue till all the squares are full. Lay the ears aside where they will not be disturbed. To keep the grains moist, place a piece of cloth, old muslin or any cotton cloth, over them and put about two inches of moist sand on top. Place in a warm temperature and keep moist.

The boys may be interested to find out just what effect different temperatures have upon the germinating power of corn. Have them suggest an experiment they can perform to test this. (Place several grains from the same ear in moist cloth or blotting paper and put some of them in a very cold, some in moderate, and some in a very warm temperature. If possible, use a thermometer to test the temperature of each place.)

The germination box will be ready for examination in four or five days. Begin at one end and carefully roll back the cloth so as not to disturb the grains. Now arrange a table of five columns. This may be placed on the board.

NO.	VIG.	WEAK	FAIL	PER CENT
1	6			100
2	2		4	33⅓
3	5	1		83⅓

In the table the first column indicates the number of the ear. Vig. stands for vigorous. The other terms explain themselves. Ear number 1 shows that all six grains have sprouted vigorously and the per cent is of course 100. Ear No. 2 has two vigorous sprouts and four failures, hence it gives but 33⅓ per cent. When the entire box has been checked up in this fashion, it will be easy to see which ears should be kept for planting and which discarded. What percent of a perfect stand of corn would you expect to get from ear No. 2? From ear No. 3? Encourage the children to make germination tests of the seed corn at home. A report on this work should be given credit in school.

PREPARATION FOR PLANTING.—Spend some time in a discussion of the fields in the neighborhood in which corn is to be planted this season. What was grown in them last year? If corn, what was the yield per acre? What preparation of the soil will be necessary before the corn is planted? It will be an interesting exercise for each boy to write a short extract on the topic, "The Machinery Needed to Raise a Crop of Corn." This should show the implements used in the preparation of the seed bed, in planting and in cultivating. It should indicate also, the ideals the boys have of good seed bed and proper methods of cultivation.

DISTRIBUTION AND ADAPTATION OF CORN.—In order that the children may appreciate what an important plant corn is, some time should be spent in looking up facts about it. One thing worth remembering is that corn belongs botanically

to the Grass family, that is, it is a relative of timothy and bluegrass, wheat and oats, sorghum and broom corn. It is one of the largest of the entire group. It differs from all the rest in bearing its seeds on a short side branch, which we call the ear. All the rest bear their seeds at the top of the stalk.

Corn is a native of America and is probably more widely distributed than any other grain. It grows in all of our states and territories, except Alaska, as well as in Mexico and Canada. While this is true, after all, the greatest amount is raised in a comparatively small area known as the "corn belt." Can you think why this is true? The great yield of corn in the corn belt is due to two important factors, climate and soil. Here the soil is deep and rich and there is enough rain and sunshine to enable the corn to reach its climax growth.

If you should move one hundred miles farther north and take seed corn with you and plant it, what would probably be the result? Your crop would fail to mature, because the seed you have brought with you is not accustomed to the new conditions of soil and climate.

The farther north you go the smaller ears you find. The grains are shallow and have a smooth, round crown. They contain less starch and more of the horny material. The stalks are shorter, smaller and have less woody material in them, hence are better adapted for fodder than the larger corn. This kind of corn is called Flint.

Here in Illinois we raise Dent corn. The crown of this corn has a deep dent. The grains are deep and contain a vast amount of starch. The stalks are much larger and harder than Flint corn.

PLANS FOR CORN-GROWING.—If there is an agricultural club in the school, encourage the boys to begin at once making plans for a corn-growing contest. They should feel the importance of testing their seed corn and using the best known methods to prepare the seed bed, plant, and care for their crop. If there is no club, organize one or encourage the boys of the class to start corn plots of their own.

WHEAT

In localities where wheat was studied in the fall, continue the work this spring. Have the pupils recall what was done with the wheat in the fall. When was it planted? Was it sown broadcast or in drills? Was the seed home-grown? Do you know the name of the variety used on your home farm?

The children should be given some observations to make outside of school. Has any of the wheat remained green over winter? Has any of it been winter-killed? What kind of winter weather is hard on wheat? Examine some of the plants. Dig up one and note the root system. How deep do the roots go? Determine as accurately as you can how far they spread out on each side of the plant. Have any new leaves developed this spring? On what part of the plant are they? Are the stems erect or spreading? Is this habit of growth any advantage to the plant? (This is a protection. If the plants had grown erect instead of spreading out last fall, they probably would not have stood the winter conditions as well as they did.)

The outdoor observations with reports may continue throughout the term. Watch the development of the plants. How many stems grow from one cluster of roots? This whole group of stems arising from one cluster forms what is called a stool. When does the plant begin to send up the stem which is to bear the grains? From what part of the plant does this stem arise? Are there any leaves on it? Is it hollow? What is the average height of the stems? Measure several and compute the average. Are the stems in the field nearly equal in height?

About what time does the wheat begin to "head?" This head which is called a spike is really a cluster of flowers. You may be interested to open up one of the small flowers to see if you can find the stamens and pistil. (In wheat, the stamens and the pistil are in the same flower and are so arranged that the pollen rarely escapes from the flower.) Do you think there is any possibility of cross-pollination in wheat? How long is it after the flowers have opened before the grains are ripe? Note the change of color that takes place as the wheat matures. Which leaves stay green longest?

How many heads do you find arising from one stool? How many good grains in one head? Compare several heads in this respect. About what date is the wheat harvested in your neighborhood?

APRIL AND MAY

OUTLINE FOR APRIL AND MAY.—*Seed testing. Examine clover and grass seed with hand lens to find weed seeds and other impurities. Compare weed seeds with those collected last fall to identify kinds.*

Principles of landscape gardening. Study placing of shrubs, trees, vines and flower beds on home and school grounds; plan to set out shrubs on Arbor Day.

Birds beneficial to farm crops; quail, meadow lark, native sparrows, thrasher. Birds of prey.

Study clover plants, habbis of growth, length of roots, tubercles on roots. Identify other legumes; examine roots for tubercles. Prepare small plots, where favorable, and plant alfalfa with and without inoculation.

Arrange plans for vacation studies and experiments with corn, potatoes, clover, wheat, fruit tree; vegetables and flower studies for girls.

SEED TESTING.—For testing seeds a hand lens is necessary. The purpose of this study is to help the pupils to identify different kinds of seeds. Begin with discussion of the kinds of clover that the pupils know. Who in the neighborhood expects to sow clover this spring? Is clover sown by itself or with other crops? Do farmers in the neighborhood sow clover in the same field with oats? With wheat? With timothy? What is the purpose of sowing it in some particular field? Is it to be left a number of years to make a meadow? Is it to be plowed under in a year for the purpose of improving the soil?

Ask the pupils to bring small samples, about a teaspoonful, of the clover seed which their fathers may be going to plant. (It will add to the interest to make a collection of different kinds of clover seed.) Spread some of the seeds out on a sheet of white paper. Look at them first with the naked eye to see if you can find any objects which are certainly not clover seed. Do you find seeds of some other kinds? Are any of the clover seeds too small and shriveled? If possible, examine also with a hand lens.

Place all of the shriveled seeds, weed seeds, and other foreign bodies in one pile, and the good clover seeds in another. About what per cent of the whole is good seed?

In preparation for the further study of clover, plant a few seeds in a pan or box of soil in the school room. Keep well watered. Keep record of the date of planting and of the date of the appearance of sprouts. Plant seeds at different depths, some an inch, some half an inch, some a quarter, and some on top of the soil. Keep records of the germination and growth of the plants.

Compare any weed seed that may be found in the oats, clover, or grass with those stored away in the collection last fall. If some of the seeds cannot be identified plant them in soil and watch for the growing plant hoping in this way to identify the seeds.

ORNAMENTAL PLANTS.—If nature-study does all that it should for the boys and girls, it will not only help them to appreciate the wild life of woods, fields and waysides, but it will also lead them to take pride in making beautiful their own homes and surroundings.

TREES.—Begin the work with an informal discussion of ornamental plants. Ask the pupils how they would classify them. Lead them, for themselves if possible, to recognize the following groups: trees, shrubs, vines, and flowering plants. Make a list of all the trees of the neighborhood that the pupils know. Are these trees native to the soil, or were they set out? Distinguish as far as you can between those which grow naturally in your environment and those which have been introduced. A few lessons should be devoted to getting acquainted with these trees. Usually, if necessary, someone can be found in the neighborhood able and willing to help the teacher in her identifications. In getting acquainted with a kind of tree, study the characteristic, general shape, the color of the bark, the method of branching, and the nature of the twigs as to whether they are stiff and erect, or slender and drooping.

How are the buds arranged on the twigs? Are the leaves opposite or alternate? Compare the twigs of different trees in this respect. What advantage in the great number of buds? Would it be possible for all the buds to develop into branches? Watch for flowers and the formation of fruit. Bring out opinions upon which trees are most beautiful. Which most desirable for shade? What objections to the cotton wood as an ornamental tree?

Are there any trees in the school yard? What kinds? Are they in good condition? Have they been abused? How are trees injured? Are the trees in the yard well located? Why are trees usually transplanted before spring begins? Is the school yard large enough to permit a belt of trees and still leave plenty of play ground?

Bring out opinions as to the best places on the school ground to set out trees. There should be at least a row of trees on each side of the lot and a few trees in the rear. Do you think there should be many trees in front of the school house? This is not considered a good plan, since an unbroken expanse of lawn in front of a house is much more attractive. To have a row of trees outside the yard, along the roadside, is considered a good plan.

Have the pupils draw a simple plot of the school grounds, putting in the buildings, and have them indicate where they think trees should be placed.

SHRUBS.—Are there many shrubs in the home yards, in the school yard, along the roadsides or in the fence corners? Make a list of the shrubs the pupils know. How do shrubs differ from trees in their habits of growth? Nothing helps more to make a school or home yard attractive than a few well chosen shrubs. Where shall we place them? They should not be planted singly. They should be planted in clumps so as to produce a mass effect. A clump at the corner of the building, another where the platform, or steps, or ante-room meets the main building, another in a corner of the yard, and a few to screen the outbuildings. These are enough, unless the yard is very large, to produce a very pleasing effect. Where the yard is very large, a few clumps along the side of the lot, making an irregular border, is an excellent arrangement.

How shall we arrange the shrubs that go to make up a single clump? If they are at a corner of the building or yard then the tall upright shrubs should be placed in the rear that is, farthest from the center of the yards, and lower ones in front. A very pretty clump for a small space is made by placing spirea (bridal-wreath) behind, and a Japanese barberry on each side toward the front. In a corner of the yard nothing is better than our native sumach, which turns such a beautiful dull red in the fall, or our native elder. These should be in the background and may be bordered with barberry, dogwood, or snowdrop.

VINES.—Make a list of vines which the pupils already know. We may plant either hardy, perennial vines, or annuals, the latter being the kinds which die completely in the fall and must be started from seeds again in the spring. Of our native hardy perennials nothing is better than woodbine, which is also called five-leaved ivy. Of the annual vines, the climbing nasturtium, the morning glory, and the wild cucumber are good and easy to grow.

Where shall we place the vines? If the yard is fenced, the back fence is an excellent place for a vine. Outbuildings should be covered with vines. It is better to begin with these places than to try to plant against the school house walls. There are certain objections to that.

FLOWERING PLANTS.—Every school yard should have a few flowering plants, even if there is no regular school garden. A flower bed a few feet wide, bordering a clump of shrubbery, gives a very pretty effect. A narrow bed along the back fence, with vines as a background, is a thing of beauty either at school or at home. It is never wise to place a flower-bed in the middle of a grass plot. Discuss with the pupils where flowering plants shall be placed at home and in the school yard. What are some of the characteristics that are desirable in plants that are to be grown on the school grounds? In the first place we want hardy plants that can stand dry weather without watering. Then we want plants that will be in flower when school begins in September. The following list is a good one for school grounds: Sweet alyssum, candytuft, dwarf marigold, petunia, phlox drummondi, prince's feather or cock's comb, zinnia, scabiosa, gaillardia, cosmos, larkspur, balsam, sunflower, nasturtium, corn flower.

Discuss what points should be considered in selecting plants for a flower bed. The height of the plant is one important point. We want the low plants along the border of the bed and the highest ones to form a background for the others. The color, too, must be considered. It is not in good taste to plant a great many different varieties in one bed but choose the two or three that harmonize well in color. Sweet alyssum makes an excellent border plant for any group of flowering plants.

Since phlox has so many different colors a whole bed of that is pretty. Sweet alyssum with gaillardia and princes' feather makes a pretty group. Cosmos makes a good background for almost any of the other plants. Candytuft and larkspur make a pretty white and blue group.

A few definite directions for planting may be given. The soil should be worked up with a rake till it is fine. If straight lines are desired they may be made with a cord stretched from one wooden peg to another. Furrows for small seeds may be made with the handle of a rake or hoe. Seeds should, as a rule, be planted at a depth equal to about four times the thickness of the seeds. Very fine seeds like petunia may be sown on the surface of the ground and then lightly sprinkled with fine soil. The soil should be well-firmed over all seeds. Some seeds will not grow at all in loose soil.

ARBOR DAY.—All of this study should reach its climax on Arbor Day. Plan on this day to do something to make the school surroundings more attractive. If you cannot plant many trees or shrubs, plant one, and do that so well that it will grow and add its influence toward having more done next year. Let the children help to decide what trees should be planted. Some of them may have growing about their homes, seedling elms, maples, box-elders, etc., that they will be glad to have transplanted to the school yard. Discuss where the trees or shrubs should be planted to give the best effect, and yet be out of the way. How to plant the trees should be settled before attempting to set them out. Some points to observe are the following: The hole should be large enough to allow the roots to spread out to their full extent. It should be deep enough so that the tree may stand three or four inches lower than it did as a seedling. The roots should be kept moist until ready to set in the ground. Fine soil should be placed around the roots and packed in carefully. As more soil is thrown into the hole, it should be packed down firmly by tramping it with the feet. The last two or three inches of soil should be fine and left loose to help keep in the moisture. The soil should be moist, but not wet. Most horticulturists believe that the trees do better if not watered at the time of planting. The trees should have most of the branches cut off. A young tree will do better than a large one. The weeds and grass should be kept down a few feet around the young tree. Cultivation of the soil now and then by digging around the tree not only gives a chance for the air and water to enter the soil, but the frequent stirring of the soil on top helps to retain the moisture.

The Arbor Day program should be made so interesting that the patrons of the school will be glad to witness it. Ample suggestions are to be found in the annual bulletin on Arbor and Bird Day issued by the State Superintendent's office.

Encourage the pupils to plant some shrubs and trees at home, and begin to form plans to plant some flowers next month.

BIRDS.—Devote one lesson to a discussion of the birds that the pupils have seen in the neighborhood this spring. Ask them to watch for birds on their way to and from school. Notice where the birds are and what they are doing.

QUAIL.—How many have quail on their farms? How many have heard the quail whistling "bob white"? what are the colors of the quail? Is there any white on the head? Do the birds hop or walk? Do they fly high or low? fast or slow? What do they eat? (It may not be easy for the children to answer the last question by observation, but they should know that careful studies of the food of the quail have been made by bird students and that these birds must be regarded as real benefactors on any farm. They feed upon chinch bugs, army worms, Colorado potato bug, clover leaf beetles, cucumber beetles, grasshoppers, flies, and wire worms. They are "worth their weight in gold" to every farmer.)

MEADOW LARK.—How many know the meadow lark? What is the color of the breast? (bright yellow.) Look for the black crescent-shaped spot on the upper breast when it flies. Look for the white tail feathers. How many different songs does the meadow lark have? (It has a clear, beautiful whistle, its chief song; then it has a low cackling call note that you hear most frequently from the ground when the bird is slightly alarmed.) Where does the meadow lark feed? (Chiefly upon the ground. It eats about the same kind of insects the quail does. It has been estimated that more than half of the meadow lark's food consists of harmful insects. The meadow lark and the quail head the list of birds that are beneficial to farmers.)

SPARROWS.—Our native sparrows are field birds that every boy and girl should know. There are three of these that are very common. They are the song sparrow, the field sparrow, and the vesper sparrow. They resemble each other somewhat. All are small birds with brownish striped backs. All are pleasing songsters. They are noted seed eaters. During the fall and early spring they destroy millions of weed seeds. During the summer they live largely upon insects. Besides the real sparrows there are two relatives of these birds that are frequently found along the hedge rows of many fields. One is a bright blue bird, blue all over. It sits on telephone wires and sings from morning till night. It is called the indigo-bird or blue-bunting. The other is sometimes called the little meadow lark. It has a yellow breast with a black spot somewhat similar to that of the meadow lark. It, too, is a great singer, and like the indigo-bird loves to sit on the topmost twig of the hedge or on the telephone wires and sing all day long. The right name of this bird is dick-cissel. It has been given this name because its song sounds like dick, dick, cissel, cissel. Both of these birds feed upon insects during the nesting season just as the sparrows do.

BROWN THRASHER.—Another common field bird is the brown thrasher. This is sometimes called the brown thrush. How many know it? What is the color of back? The breast? Is the bill long or short? What is the color of the bill? Notice the long tail. Listen for the song. It has so many notes that it is sometimes called the mocking bird. It belongs to the mocking bird family.

CLOVER AND OTHER LEGUMES.—If clover seeds were planted as suggested, check up the experiments and decide what depth of planting gives best results. Examine an oats field in which clover has been sown. Which germinates first, oats or clover.

Study red clover plants that are at least a year old. (Clover plants may be found in almost any locality in fields, meadows, or by the roadside.) An outdoor lesson should be planned. If it is not practicable to send the class out during school hours then give them the topics to report on the next day.

Note the habit of growth of the plant; a rather loose rosette close to the ground. How many stems do you find in one rosette? Do the stems branch? Where do you find the new shoots appearing? Is there any advantage to the plant in growing this close to the ground with new shoots at the center? Bring out by discussion the chance this gives for the natural coverings, leaves and snow, to protect the plant during the winter. Note the arrangement of leaves and the number of leaflets. Later compare with other clovers to determine whether this is a common characteristic of the clover family. What special markings has the red clover leaflets? (The light green spots.) Look at the leaflets after sunset to see if they remain in the same position as during the daylight.

Dig up a plant and bring it into the schoolroom for study. Note the size of the root. How long is it? Does it branch? What advantage is this thick, long root to the plant? (By discussion bring out the fact that the thick root stores up a supply of food that enables the plant to grow rapidly early in the spring. The long root is an advantage also in dry weather since it can get a supply of moisture at a considerable depth below the surface of the ground.) What advantage is the root to the soil?

Look at the roots for small roundish bodies about the size of pin heads. These small bodies are called tubercles or nodules. Where do you find the tubercles most numerous? Count the number on a small root. What are the tubercles? They are growths on the root caused by small living organisms known as bacteria. These bacteria take from the air in the soil the free nitrogen and act upon this in the tubercles so that the plant can use it just as it can the more usual supply of soil nitrogen that enters through the root hairs in solution in the soil water. From your study of soils and the elements they contain that are used by the plants in making foods, you know that nitrogen is often lacking in the soil and that to supply it with commercial fertilizers is an expensive thing to do. It is very much cheaper to sow clover and let these bacteria gather the nitrogen from the air and in this way give a fresh supply to the soil.

Instead of harvesting the second crop of clover many farmers plow it under. Why? Because the roots and stems add nitrogen to the soil for other crops, and because the leaves of the clover decay quickly and enrich the soil by a fresh supply of humus. Have the pupils look for other clovers in the neighborhood and bring in

specimens for study. Sweet clover and white clover will be found in abundance and in some places alike clover and alfalfa. Note the characteristics common to these plants. Examine the roots to determine whether or not all have nodules. Study the stem of the white clover. Note how the plant spreads over an area. Why is it a good lawn plant?

All of these plants are called legumes. They have certain characteristics that are common to all. Beans and peas belong to the same group of plants known as Leguminosæ or legumes. They have been given this name because they all have their seeds in a flat pod which is called a legume. All of the legumes have the bacteria nodules on their roots so any of them are good plants to supply nitrogen to the soil. In some places soy beans and cow peas are planted for this purpose.

VACATION STUDIES.—Birds.—Where do quails nest? How do young quail try to protect themselves? (Some boy may see the little creatures lie flat upon the ground keeping perfectly motionless and resembling so closely brown leaves or clods that it is very difficult to see them.) Do quail stay with us during winter? What do they eat when insects are all gone? Like many other winter birds they feed upon weed seeds and waste grain. Sometimes the snow covers up all food and then the birds suffer and many die. What may be done to save these useful birds? It will pay every farmer to feed the birds during such seasons. Every farmer should also see to it that no quail is shot upon his premises during the hunting season.

Watch for the nesting places of the meadow lark and brown thrashers. Try to find out what these birds feed upon. Start a bird calendar and try to keep it during vacation. The following is a simple calendar:

Name	Where seen	Chief colors	When seen	Nesting	Last seen

FLOWERS.—Encourage the girls to plant some flowers and vegetables to display at the Harvest Festival in September. A simple record of the work done and the results gained should be kept.

CLOVER.—Study the flowers. Are they arranged singly or in clusters? Decide whether or not the clover head is a single flower or a number of flowers. Find the parts of one flower; compare with a bean or pea blossom. How many flowers do you find in one head? Which flowers open first, those at the outside of the head or those at the center? Examine a number before deciding. Examine some faded heads for the seeds. Does one little flower produce more than one seed? When is the clover cut for hay? How does it compare with other kinds of hay as to value? (The stem and leaves contain more nutritious food than almost any other hay with the exception of alfalfa.) Watch for the beginning of growth of the second crop. Does the second crop produce flowers and seeds? When is this crop harvested? How are the seeds obtained?

Watch the bumble bees on the clover. Can you see where the bees put their tongues to get the nectar? Where is the nectar secreted in the flower? If you remove one of the small flowers and put the tip of the corolla tub in your mouth you can taste the sweet nectar.

LESSON PLANS FOR EIGHTH YEAR

SEPTEMBER

OUTLINE FOR SEPTEMBER.—*Report vacation studies and experiments. Plan out of school work as suggested for seventh year. Farm calendar. A simple survey of the industries of the district. Make a list of the crops raised in the neighborhood during the year. Which ones have been harvested? Has more than one crop been grown in one field? Acreage and yield of different crops. Each pupil make map of home farm, showing fields.*

FUNGOUS DISEASES.—Simple study of much rooms, how fungi differ from seed plants. Experiments in growing and destroying molds and bacteria; sterilization; treatment with formalin; smut, rust, blights, rots, scabs. How combat these? Fungi that attack insects; find flies and grasshoppers that have succumbed to fungous diseases. Simple experiments. Collection for school.

VACATION PROJECTS.—In districts where the outline for the seventh grade was carried out last year simple, informal reports of the vacation experiences may come first. Encourage the boys and girls to tell about their work. What projects they undertook, what difficulties they encountered, what success they had, what is the present status of their experiments, what products they have grown that may be shown at the Harvest Home festival the latter part of the month.

Incidentally it may be stated that no formal work can give better training in language than these reports if given in a clear, direct, natural manner. Therefore, if time is lacking for the nature study it may very well be correlated with language.

PLANS FOR OUT-OF-SCHOOL WORK.—Plans for work outside of school hours may mean several things and if undertaken should begin early in the term. It may mean a completion of the projects undertaken in the spring, the harvesting, storing, or marketing products of the farm or garden. If chicken raising was undertaken it may mean caring for the flock. The pupils will keep a simple record of the work done and the time spent. This will be handed in at the end of the month.

The out-of-school work may mean that a child will choose a special piece of work to be done at home, as the feeding of the pigs, the care of the chickens, milking, setting the table, etc., for which credit will be given at school. This plan requires the most tactful management and perfect cooperation between the parents and the school. Only the earnest, sympathetic teacher who knows and understands her patrons and in spirit is one of them should attempt this.

The third kind of work is for the boys who do not enter school until after corn husking. There is no good reason why these boys should not combine observation and study with their home work. In fact with a little help they may be able to cover much of the work done by the children in the school. If they are interested a club may be organized, if one does not already exist. By meeting once a week to discuss observations made, and to receive directions for further work the boys may be able to keep in touch with the school work and even to contribute something to it in the way of specimens and individual observations.

SURVEY OF NEIGHBORHOOD INDUSTRIES.—This topic may be carried out with profit in any part of the State. It affords an excellent opportunity for originality on the part of the pupils. It should consist of a real survey of the district conducted by the individual members of the class. Its purpose is to help the children appreciate the scope of the work done in the district, the relation of the industries to each other and to the outside world, and the facilities for educational and social advantages. It should include: The number and size of the farms in the district. The number of farmers living on their own farms. The number of tenants. The kinds of farming practiced, stock or grain or a combination. Kinds of crops with acreage of each—average yield per acre—number and breeds of domestic animals—other industries than simple crop or stock farming; fruit-growing, dairying, truck gardening—means of transportation, hard roads, dragged roads, old style earth roads, railroads—the nearest market—facilities for social and educational life of the community, clubs, the Grange, church, school, etc. The survey should include also statements

of the present condition of the fields and the work that is in progress. What crops have been harvested? What has been done with the stubble fields—with the straw? Does the same soil produce more than one crop during the season?

The children should be given several weeks to work up the survey. A simple plat of the district drawn to a scale showing the farms and indicating with colored crayon different crops or other interesting features will add much to the value of the work.

In connection with the study of the district each pupil will be interested to draw on a larger scale his own home showing the location of the buildings and roads, and indicating in color, the orchard, garden, and different field crops.

While the survey will be of value to the pupils it will be equally valuable to the teacher. It will help her more than anything else to see and appreciate the industries and interests of the people and to meet them upon the plane of those interests.

MUSHROOMS AND TOADSTOOLS.—Have the children bring in a number of mushrooms. They will probably call them toadstools. The common meadow mushroom is usually abundant in the fall, so are a number of cluster mushrooms that grow at the base of old stumps. Where are the mushrooms found growing? (By discussion it will be brought out that they are found in the woods, around stumps, on trees, in meadows, around barns, etc.)

How many parts do you find in your mushroom? The stem is called the stipe, the umbrella-like part, the pileus. You may find small whitish threads attached to the end of the stipe. These make up the mycelium which penetrates the ground or stump or whatever the mushroom may be growing upon. What do you find on the under side of a pileus? Those leaflike flaps are called gills. What are they for? To answer this question break the stem out of the pileus and then lay the pileus on a piece of white paper with the gills downward. Leave it for twenty-four hours. What do you find on the paper? Rub your fingers over it. This fine powder is composed of tiny bodies like pollen grains, each of which is called a spore. These spores are for the production of new plants. Name some of the ways in which a mushroom differs from the other plants you have been studying. They lack leaves, green color, flowers and seed.

MOLD.—About a week before time for this lesson place moist pieces of stale bread on a piece of pasteboard and turn tumblers over them. Have pupils examine the bread. What is on it? On what part of the bread is the mold most abundant? Look closely at the mold. How many distinct parts can you see? (The mass of threads is the mycelium.) Do any of the threads penetrate the bread? Those standing out from the mycelium with tiny white or black dots on the end are spore-bearers and the dots are spore cases. Touch gently with a pin a group of these black spore cases. What happens? The cases burst open and a shower of minute spores come out. What are the spores for? Let us plant some of these spores and see if they will grow.

Moisten a fresh piece of bread and with a small stick or end of a match transfer some of the spores to this. Plant them in rows. Turn a tumbler over the bread and examine after forty-eight hours. Have the spores germinated? Let the bread stand to find out how long before this new crop of mold has ripe spores on it.

Where did the mold come from on the first piece of bread? The spores must have been on it when it was moistened and put under the tumbler. They must have been in the air and dropped upon the bread. Why does stale bread mold more quickly than fresh? Why does canned fruit mold? Can mold spores be killed?

Pour boiling water over a small piece of stale bread and turn over it a tumbler in which you have just dashed boiling water. At the side of this place a piece of the same kind of bread that is soaked in cold water and has a cold tumbler over it. Watch for developments. Why do you pour boiling water in fruit jars before canning fruit? Why should lids of the jars be sterilized in the same way?

Soak a piece of fresh bread in a half glass of water in which you have placed a few drops of formalin. Plant spores on this as you did on the other pieces of bread. Do these spores grow? Why? Formalin or formaldehyde kills the spores as effectively as the hot water. However, it cannot be used about the house for it is poison to human beings. It can be used, however, to great advantage in killing spores that produce fungous diseases of plants.

What does the mold feed upon? The mushrooms? They obtain food from the substances upon which they grow. What part of the plant do you think gets the food? By discussion it may be brought out that the threadlike mycelium which pene-

trates the substances obtains the food. All fungi such as mold and mushrooms that live upon dead organic matter are called saprophytes.

Do all fungi live upon dead organic matter, as bread, stumps, etc.?

Find some ears of corn covered with smut. Examine this. What is it composed of? The mass of black sooty material is chiefly made of spores. What is the effect of this fungus upon the ear of corn? The smut plants have really penetrated the young grains of corn, and have lived upon these grains. Has this fungus many or few spores? Much corn is destroyed by this disease. What other grains are attacked by smut?

If you have a few heads of oats or wheat with smut on them, make a study of these. Can you find any spores in these? What will every spore produce? A new plant, like all the other fungi studied, the spore forms the mycelium. It usually begins its growth when the oat plants are about an inch high. The threads of the fungus feed upon the growing oats, sometimes so weakening the plant that it dies. Most of the plants live, but are dwarfed. About the time the heads appear the smut is ready to produce its spores so it sends the ends of the threads with the spore cases on them outside the oats grains. You find the heads black with spores instead of having grains. Do you think any of the oat seeds are likely to have spores on them if they have grown in a field where some of the heads have been affected with smut? Can you think of anything that might be done to kill these smut spores?

Formaldehyde will kill these spores just as readily as it did the mold spores. The following recipe is used by many farmers: Put one pint of forty per cent formaldehyde in thirty-six gallons of water, soak the seeds in this for ten or fifteen minutes, and then spread out to dry. This is sufficient for about forty bushels of seed. The seeds are more easily handled by putting them into a gunny sack, and putting this into the solution. Wheat smut may be treated in the same manner.

Examine spots of rust on wheat or oats. Can you find any spores here? Are these fungous diseases? This is another fungus that feeds on the inside of the leaf or stem till it is ready to produce spores when it sends the hyphæ to the surface and the spores are produced on the outside. The ripe reddish-brown spores on the wheat look very much like iron rust, hence the name. Have the children name other fungous disease, as pear and apple blight, peach rot and potato scab.

The children will be interested to know that plant breeders have been experimenting for some time with various varieties of wheat and have succeeded in producing several varieties that resist fungous diseases altogether.

OCTOBER

OUTLINE FOR OCTOBER—FARM CALENDAR.—*Discuss last month's work and plan to keep a calendar for each month.*

FORAGE CROPS.—Grasses, those best adapted for meadows, for pastures, varieties found in neighborhood. Use of leguminous plants for forage. Other forage crops—kafir corn, sorghum, millet, rape.

Review in this connection the corn study of seventh year.

PLANT SOCIETIES.—Simple study of the living together of plants and animals. A meadow or pasture group, a corn field group, a forest group, etc.

THE FARM CALENDAR.—The farm calendar with a discussion of the farm work during September should be given at least one period at the beginning of the month. It will be of interest to have the pupils compare their last year's calendars with the present one, noting variations and changes in the work of the two years.

FORAGE CROPS.—There is no part of the state where the study of forage crops may not be taken up with profit. The first lesson should be given over to a discussion of what is meant by forage. The term originally meant "Food," and was probably first applied to pasturage when animals were dependent upon wild plants for their food. Now it means any form of herbage either green or air cured, used as food for domestic animals. It consists usually of the leaves, stems and sometimes the seeds of a number of different kinds of plants, and includes pastures, meadows, silage, fodder and soiling.

Have the pupils discuss the above terms with reference to the methods employed in using the plants for food. In pastures the animals help themselves to growing plants. Meadows are cut, the plants air-dried, cured, and stored for future feeding. Fodder

is a term commonly applied to corn or sorghum, that is cut before maturing and piled up to dry and cure slowly. Silage is food cut green and preserved in a succulent state by packing closely in a silo. Soiling is a term used for green plants of any kind that are cut and carried to the animals, such as green fodder or cow-peas.

Forage crops may be grouped also with reference to plant species as follows:

1. The small grasses, as timothy and blue grass.
2. The large grasses, as corn and sorghum.
3. The legumes, as clover, alfalfa, and cowpeas.
4. Root crops, as turnips and beets.
5. Miscellaneous, as rape, cabbage, and pumpkins.

Have the pupils make a list of the different forage crops raised on the home farms. Indicate the acreage of each. Does anyone in the neighborhood practice soiling? This means raising a crop that may be cut and fed in the green state to stock. Who raises summer forage, or catch crops? Winter or cover crops?

THE SMALL GRASSES.—Make a list of the different kinds of small grasses grown in the neighborhood. Assign for out-of-door observation at least two kinds of grass, one pasture and one meadow. Blue grass is the most familiar pasture grass in Illinois. Note the relation of the plant to the soil. Is it hard or easy to identify single plants? Do the blades or leaves spread out on the ground or stand erect? Dig down and find the parts of the plants in the soil. What kind of roots do you find? Thread-like roots of this sort are called fibrous roots. Look among the fine roots for a thicker, harder thread that is made up of joints. If it is fresh, it is white in color and has at the end a bud from which new leaves are growing. This long, slender body is called a root-stock. It is an underground stem and not a true root. If you look closely you will find that it has thin scale leaves at every joint. What direction does the root-stock grow? Can you see how it enables the blue grass to spread and cover the ground so closely? In dry or very cold weather, when the parts above the ground are dead, the root-stock with its new buds, remains alive. Just as soon as conditions are right, that is, when the rains come, new blades spring up, and we soon have a fresh crop of grass. It is this characteristic that makes blue grass one of the best pasture plants. Is it an annual or a perennial? If the children are in doubt, tell them to wait and settle the question by their own observation. They will be able to decide before spring that blue grass is a perennial, and that in sheltered places or when covered with snow, it remains green all winter.

Compare timothy or orchard grass with blue grass. Note the different methods of growth, the larger blades, and the lack of root-stocks. Do you think timothy or orchard grass could ever make as dense a sod or turf as blue grass? Why?

Obtain, if possible, heads of different grasses and make a comparative study of these. It will add interest to have the pupils make a collection of the different kinds of heads and also of the seeds of the different grasses. These may be collected into a pretty booklet.

Common grasses grown in Illinois, besides the ones mentioned above, are meadow fescue and red top. The latter is grown largely in the southern part of the state. It is used both as pasture and meadow grass. Millet is a coarse grass used in many parts of the state as a summer grass, that is, it is sown at late as July and manures a crop by early fall. It is grown in many places as a catch crop on areas from which early potatoes or some other crops have been harvested.

Procure some millet plants for study. Note their root system, the height of the plants, the length and width of the leaves, and the large heads. Remove some of the seeds from the heads and compare with those of other grasses. If several farmers in the district raise millet, obtain plants of different kinds and compare as to height, softness of the leaves, and size of the heads. There are a number of different species grown in the state. Among these are the common small millet, German, and Hungarian millet. Discuss the proper time to cut millet for hay. No kind of millet should be allowed to reach maturity before cutting, but should be harvested soon after blossoming. Do you see why? If allowed to grow too long the stem and leaf fibers become so hard and tough that they are not good for feeding stock.

THE LARGE GRASSES.—Large plants belonging to the grass family used for forage in Illinois, are Indian corn, Kafir corn and sorghum. Review briefly the study of the corn plant as given in October of the Seventh year. Compare Kafir corn and sorghum with Indian corn. Note the resemblances as shown in the stalks, leaves and roots. Note differences. The main difference between Indian corn and the other

two is that Indian corn has two flower-clusters, the tassel or staminate flowers which bear the pollen and the shoot or pistillate flowers which bear the seeds. Sorghum and Kafir corn have both stamens and pistils in one large flowering head at the top of the stalk.

Kafir corn is not used largely in this state, but sorghum is coming into great favor as a forage crop, especially for cattle. It contains more food properties than many other forage plants. It may be pastured when a few feet high and will continue to send out new leaves. It is valuable as a soiling crop and also for fodders, which may be fed early in the winter. In some places it is mixed with corn for silage.

LEGUMES.—Red clover is the chief legume used for forage in Illinois. Alfalfa and to some extent cow peas and soy beans are coming into use. These plants are called legumes because the seeds are formed in a flat pod known to botanists as a legume. All common beans and peas are legumes. Clover pods are small but are as perfect as those of the larger plants.

Review the study of clover as given in the spring term of the seventh year. How many farmers in the district have clover on their farms? What was done with the first crop this year? The second crop? How much seed will an acre of clover yield? What is it worth per bushel? Study root tubercules on the small roots. Are they are numerous as they were in the spring?

If there is any alfalfa growing in the neighborhood make a detailed study of the plants, comparing with the red clover. Study the common sweet clover found by the roadside. This is a near relative to alfalfa and is quite similar in its characteristics.

COWPEAS AND SOYBEANS.—Are there any cowpeas or soybeans raised in the district? Are they used for pasturage or fed green? These two legumes are comparatively new in our state and yet are considered quite worth while by many farmers. Both are native of Asia. Cowpeas were introduced in this country years ago, and have become important farm crops in the southern states. The soybean was introduced more recently, probably not more than thirty years ago. It is better adapted to a cold climate than cowpeas. It grows rapidly, maturing in from two to two and a half months. Both plants are considered excellent for the soil. They may be planted rather late in the spring or even in early summer. Some farmers plant them between the rows of corn after the last cultivation. The leaves and upper stem may be used for soiling or green fodder, while the lower stems and roots are plowed into the soil. If the greatest benefit to the soil is desired, the entire plant may be plowed under. Soybeans are excellent to mix with corn for silage. If no one in the district raises these plants, send to a seed company for a few seeds, and plan to have some of the boys plant a small plot of each next year.

MISCELLANEOUS FORAGE PLANTS.—Have the pupils make a list of any other forage plants not named above, that are grown in the neighborhood. In some localities root crops are grown for feeding cattle and sheep. If these are used in your district, have the pupils make a collection for study. The most common are turnips, rutabaga and beets. Compare the different kinds as to size, weight, shape, etc. An interesting experiment may be performed to determine the amount of water in roots. Peel one of each kind, a turnip or beet, weigh and place in a warm oven or in the sun, and weigh again after twenty-four hours. Continue this for several days and you will be able to estimate the amount of water that the root contains. While roots are not especially high in food value, they are excellent, because of their succulence, to feed with dry grain foods during the winter months.

Rape is another crop used to some extent in this state. It is used chiefly as a soiling crop or as pasturage for pigs and sheep.

Rye is another common forage plant. This is frequently planted in the fall, making a good cover crop for the winter, and may be used as pasture or for soiling in the spring.

Spend at least one lesson discussing the value of forage crops. The pupils should realize that much more attention has been given to forage crops during the last ten years than ever before. This is because farmers are giving more attention to the comparative value of different crops. The Cyclopedia of Agriculture tells us that forage crops stand second in acreage in the list of cultivated crops of the United States.

One reason for the new interest in forage crops is the knowledge that some suc-

culent foods are better for all cattle during the entire year than dry, concentrated food. This is especially true of dairy cattle. The pupils will be interested to know that in some of the large sanitary dairies in New Jersey the cows are not fed in pastures at all, but during the summer are fed on soiling crops. The dairymen claim that the greater amount of milk obtained more than pays for the extra labor required to feed in this way.

A second reason that more attention is given to forage crops is the growing demand for a crop rotation that will maintain the fertility of the soil. It has been proven beyond question that forage crops leave the soil in a much better condition than they find it. Of course this means when treated according to improved methods of farming.

PLANTS SOCIETIES.—The last topic suggested for the month will make a most interesting series of lessons anywhere. Few boys and girls have ever thought of the fields, meadows or woodlands as communities of living beings feeding and working together, some helping, some hindering, each other in their struggle for existence. Each locality differing from another, in position, slope, amount of moisture and kind of soil, has its own special society of plants and animals. This is true in wild nature, as well as in cultivated fields. The only difference is that in the latter, man comes in as an important factor, to help decide just what plants or animals shall keep possession. But he cannot completely control the inhabitants. In spite of him, certain plants and animals enter, settle down, and become a part of the community.

An interesting plan to follow in assigning the work is to have each member of the class work up a different society. One may choose a cornfield society, another a pasture, still others the meadow, vacant lots, garden, woodland, swamp, or pond. The same outline with a little modification will answer for all. For example, make a list of all the different plants you find in the corn fields. Here is a good opportunity to review the weeds we studied last year. Where are the weeds growing most luxuriantly? How close to the corn do they grow? Are any climbing the stalks? Any trailing on the ground? How do they compare with the corn as to height? Which plants have succeeded best, corn or weeds? Is there any part of the field where the weeds seem to have the advantage? Can you account for this? Are there any lower plant forms, such as smut or mosses, in the cornfield?

What animals do you find in the corn fields? Note different kinds of insects and spiders. Where are they living? Determine as well as you can whether they are feeding upon the corn or weeds, or upon each other. Do you find any birds visiting this corn field society? What are they doing? Do you find any evidences of small mammals such as field mice or ground squirrels?

It will be interesting to compare the weeds and insects found in a pasture society with those of the corn field, or garden. Determine which has the greater number of annuals. Of perennials. How do you account for the greater number of perennials in the pasture?

The woodland society is of special interest, because as a rule man has little to do in determining the plants that have possession. The most important plants are the trees. How many different kinds can you find? Is one kind scattered throughout, or do you find numbers of the same species standing close together? Which are the largest trees? Do they show a series of heights or stories? Are the youngest trees the same species as the oldest ones? If all the oldest trees were removed, would most of those that are left represent the same species or would there be quite a different kind of forest?

Below the trees are the shrubs and vines. List those and compare with each other as you did the trees. In the same way study the herbs and then the plants growing very close to the ground, such as mushrooms and mosses.

The animal life in the woodland differs somewhat from that of the corn fields or pasture. Note the different kinds of spiders and insects that live in the shade of the trees. List as many of the birds as you know and notice their homes among the trees and shrubs. In the same way list the mammals, as squirrels, chipmunks, etc.

Teachers who wish to use the Nature-Study Agriculture as a basis for some of the composition work will find the pupils interested in writing compositions or giving oral reports on the following:

The Forage Crops of Our District.
The Value of Forage Crops.
The Plants and Animals That Live Together in a Corn Field.
A Woodland Community.

NOVEMBER

OUTLINE FOR NOVEMBER.—*Corn judging with score card. Corn exhibit and Contest.*

Dairy industry; review types of dairy cattle; feeding for milk; the silo; housing and care of dairy cow; profit in humane treatment. Separator; use and care of milk. Detection of "robber cows" by use of scales and Babcock test. Butter making; cheese.

Dairy cow contrasted with beef type; examples of different breeds; history of a few; scrapbook of pictures cut from farm journals. Report on cattle owned by families represented in school.

CORN DAY

The first week of the month should be given largely to getting ready for Corn Day on Friday. Lessons on corn judging as suggested for October of the Seventh year should be reviewed and some actual work in corn judging carried on. This will prove quite as interesting as it was last year. It will give an opportunity to find out whether the pupils are any more skillful in judging a good ear of corn than they were a year ago. Make arrangements for a program to which the patrons of the school are invited. As far as possible the topics of the program should cluster around the term's work in agriculture. The following are suggestive topics:

What I have found out about fungous diseases.

A talk on different kinds of forage crops raised in the district.

Corn as a forage plant.

Corn raising in the home district.

DAIRY INDUSTRIES.—LESSON 2.—Begin with an informal discussion of the cows of the neighborhood. The number of cows kept in each family and the purpose of keeping cows. Some may keep cows just to provide enough milk and butter for the home. Others may keep dairy cows for the purpose of selling milk and butter, while others may keep them for the purpose of raising beef cattle. Who knows what different breeds of cattle are kept in the neighborhood? There are two distinct types of cows, dairy and beef. Does any one in the class know what some of the best beef breeds are?

There are several different breeds found in America. The Shorthorns are probably the most widely raised. They are of different colors, some red, some red and white, some roan, and some almost pure white. There are probably more red ones than any other color.

Who knows the Herefords? They are becoming more and more common in many parts of our state. They are the cattle that we often see in pastures with white faces, red bodies, and white legs. Who has ever seen any black cattle that are raised for beef. We have two kinds of black cattle, Aberdeen-Angus and the Galloways. The Angus are heavier than the Galloways. During the winter the coats of the latter become very long and shaggy. The Angus are much more common in Illinois than the Galloways. Have the children make observations and inquiries as to whether any of these breeds are to be found in the neighborhood. Look in the farm papers for pictures of various types of beef cattle. An interesting scrap book or chart may be made by pasting these pictures and carefully labeling them.

LESSON 3.—What dairy breeds are represented in the district? How many have Jerseys? How can you tell a Jersey from other dairy breeds? (The color is usually a light fawn and the nose is always black.) How do Jerseys compare with other cows in the neighborhood as to the amount of milk and butter that they produce? Does any one know the Guernseys? These resemble the Jerseys somewhat in color. Usually, however, they are a little larger and have a flesh colored nose instead of a black one. Another breed of dairy cows is becoming quite common in Illinois and that is the Holstein-Friesian. These are black and white in color. Are they larger or smaller than the Jerseys? Do they give more or less milk? (They are considerably larger than any of the other dairy cows and are noted for the amount of milk they give. As a rule the milk does not contain as much butter fat as that of the Jerseys or Guernseys, but where people wish to keep cows for the purpose of selling milk this breed is considered very desirable.) Do you know whether any of the cattle in the neighborhood are kept both to give milk and to raise beef cattle? This is done to a certain extent in many places in the state, both with the Holstein-

Friesian and the Shorthorns. Who have, instead of any of the breeds named above, common red cows sometimes spotted a little with white but mostly red? This cow is a dairy strain of the Shorthorn cattle. A few of these are excellent, some are fairly good, but many are not worth keeping as far as their dairy qualities are concerned.

LESSON 4.—Where are cows kept during the summer? Winter? Let the children report on the practice in the neighborhood. Has any one barns built especially for the dairy cows? Are the cows kept here during the day or only at night? How are they fastened in? Do you suppose it pays to give the cow a good shelter and plenty of food? (Tests have been made that prove the fact that cows that are treated kindly, kept in sheltered quarters, and fed well will repay their owners by giving much larger quantities of milk.) What do cows eat in the summer? Is there always enough grass in the pastures to afford sufficient food? What weather conditions often make it necessary to feed cattle other things during the latter part of the summer and early fall? What are the cows fed in winter time? Let the children name various kinds of feeds used, different kinds of hay, etc. Are there any who allow cattle to feed in the corn fields after the corn is husked? What do they find to eat here? Who feed silage, fodder, roots, such as turnips and beets; ground feed, or oil cake? Are cows that are kept for milk fed the same kind of food as cattle that are fattened for beef? (Some recent experiments seem to show conclusively that dairy cows do best on a feed in which there is some green material rather than all dry. For this reason many farmers are constructing silos for the purpose of preserving the corn and other plants in a green condition.

LESSON 5.—Who has ever seen a silo? What shape was it? Some silos are round, some rectangular. Some are as tall or taller than the barn. Others are not more than ten or fifteen feet high. Corn is put into the silo while it is still green. The stalks are cut close to the ground. They are then cut up into small pieces, or sometimes shredded. These pieces are put into the silo and packed down as firmly as possible. The whole mass then ferments and heats and keeps in a good condition. If it is not packed firmly the air enters and causes it to mold and decay. Corn in the silo is called silage. Cattle, and in fact, all stock are very fond of silage. Many experiments have been performed which prove that silage is one of the cheapest and best foods for dairy cattle.

MILK.—LESSON 6.—Of course, the purpose of keeping dairy cows is that they may provide good milk. Who knows what milk is composed of? (It is made of several different constituents. We know by tasting it that it is sweet. That means that it has sugar in it. We call this milk sugar. Another of the important ingredients is fat. This is known as butter fat. There is also some proteid in it and a very small amount of minerals. All the rest of the milk, which after all in the main part, is water. You will see then, that milk contains all the food which your physiology tells you is necessary for the growth and development of human beings.)

Place some fresh milk in a bottle or tumbler. Allow it to stand a few hours. What happens? Why does the cream come to the top? What does a cork do when you put it in water? Why does it float upon the water? Cream comes to the top of milk for the same reason, that is, because it is lighter than the milk.

LESSONS 7 AND 8.—Have the children discuss the methods used in their homes for separating cream from milk. Some people use crocks or shallow pans. Fresh milk is put into these and allowed to stand. The cream rises to the top and is then skimmed off by a flat skimmer. This is the old fashioned method but it is still used by many people. It is by far the poorest method known. It has been estimated that at least one-fourth of the butter fat is left in the skimmed milk when this method is used. Does any one in the neighborhood use a deep can? Some of these are twenty inches deep. The milk is placed in it and is usually kept cool by placing the can in water. Sometimes the cream is skimmed off as it is from the shallow pans but a better way is to have a faucet in the bottom of the can. When the cream has risen the faucet is turned and the milk is drained off. Then the cream is drawn off through the faucet. This is considered a much better method than the shallow pan. Much more butter fat is obtained in this way.

Has any one in the neighborhood a separator by which the milk and cream may be separated at once without allowing the milk to stand? The separator is a machine that is worked by means of a crank. The main part is a cylindrical bowl that

holds the milk that revolves rapidly. What happens to the milk in this cylinder? Tie a piece of chalk or some other object to the end of a string about eighteen inches in length. Let some child take hold of the end of the string and whirl it rapidly. Can you feel the string pulling? Let go while you are whirling. What does the string and weight do? The force that made the string pull on your hand and caused it to fly in a straight line when you let go is called centrifugal force. It is the force that causes revolving bodies everywhere to move away from the center. Did you ever notice how mud and water fly from a rapidly revolving wheel? Since the milk is heavier than the cream which will fly farther away from the revolving center? The children will readily see that since the milk is heavier it will fly toward the outside of the cylinder while the cream is forced toward the inside. There is an opening toward the outside thru which the milk pours out in a stream and an opening toward the inside thru which the cream pours forth.

LESSON 9.—Does any one in the district send milk directly to the creamery instead of separating the cream from the milk at home? How is this done? Let the children who know tell about it. In many places large cans are furnished by creamery companies. A man comes around once each day, collects the cans of milk, and takes them to the creamery. The cream and the milk are at once separated and usually the milk is put back into the cans and taken back to the farms. What is done with the cream in the creamery? What is done with the cream that is kept in the homes? In both places butter is made from it. Do you churn the cream while it is sweet or wait until it is sour? Why? (Butter may be made from sweet cream but it lacks the real butter flavor and besides it does not keep well.) The cream, then, is allowed to stand until it sours or ripens. What makes it sour? (Souring is caused by some living organisms called bacteria. They get into the milk or cream through the air or utensils used about the milk. In creameries where it is not desirable to allow the cream to stand until it sours, a little cream that has in it a number of bacteria is placed in the cream which causes it to sour in a short time. This is called a starter.) What different kinds of churns do the children know about? What is the purpose of churning? (The cream is agitated violently enough to force the fat particles together. They strike against each other and adhere, the particles growing larger and larger. It is not best to continue churning until the particles are all joined together in one great mass. Churning should be stopped when the particles are not larger than a pea. If the masses are too large it is much harder to remove all the milk from the butter.

CARE OF MILK.—LESSON 10.—Since bacteria cause milk to sour and since these little creatures are abundant everywhere, what care should be taken to prevent too many of these from getting into the milk? Let the children discuss freely the various methods to use. Who has ever seen a covered milk pail? This is made with an opening just large enough to allow the milker to get the milk into the pail and yet vast amounts of dust, dirt, and hair from the cow will be kept out. Should one be careful about having clean hands when milking or taking care of milk? What should be done with all the utensils used in connection with the milk?

LESSON 11.—The children may try a number of interesting experiments in this connection. Place a few spoonfuls of milk in a tumbler or cup in which some old milk has been left standing from the day before. In another place the same amount of milk, but first pour boiling water into the cup, rinsing it well and putting the milk in while it is still warm. Tie a double piece of cheese cloth over each glass. Let these two stand side by side for twenty-four hours and note the difference. Another experiment may be tried. Place the same amount of milk into two cups. Stand them in a warm place. Cover one but leave the other uncovered. Note any difference after twenty-four hours. This experiment will help the children to see what sterilizing milk vessels will do. What do you mean by sterilizing? It is some method used to kill bacteria and the best method to use in connection with milk is to pour boiling water into everything used with the milk.

TESTING MILK FOR BUTTER FAT.—LESSON 12.—Do cows differ at all in the amount of butter fat in their milk? Agricultural stations have made very interesting experiments and reports concerning the difference in cows. Two cows may be fed on exactly the same kind of food and be given exactly the same care, but one may produce nearly twice as much butter fat as the other. A cow that does not produce enough butter fat to pay for her keep is sometimes called a "robber cow." How can you tell how much butter fat a cow will produce? (The surest way is to

test the milk with a Babcock tester.) Has anyone in the neighborhood one of these testers? It will pay any school district to keep one of these machines to test milk of different cows. Or two or three farmers could have one in partnership. Directions for testing come with each machine. If there is none in the neighborhood it will pay the teacher to make an effort to have one put into the school. A small tester may be obtained for about five dollars, a large one that holds six testing bottles for thirteen dollars.

LESSON 13.—One lesson may be given to discussing the uses of milk aside from that of making butter:—Various uses about the home in cooking; the making of cheese, of condensed milk, and malted milk. Who knows how cottage cheese is made? The children may be able to tell that sour milk after it has become thick is slowly heated and the curd separated from the water. This curd consists chiefly of the casein and albumen, which is the proteid part of the milk.

The cheese which we buy in the market is made from sweet milk. Rennet is put into it. This curdles the milk and changes it chemically. It is then heated and afterwards pressed and allowed to stand a number of weeks to ripen. What do we mean by ripening cheese? It is ripened by certain kinds of bacteria that work in it and give it its flavor. Perhaps some of the children may have visited a cheese factory and will be able to tell just how cheese is made.

DECEMBER

OUTLINE FOR DECEMBER.—*Study of horse and horsemanship; different breeds of horses in neighborhood. Care of farm horses during the winter. Similar studies of sheep and pigs.*

Public health and sanitation studies, germ diseases; demonstrate methods of disinfecting; children assist in disinfecting schoolroom; work of the health officer; pure food; pure milk; pure drinking water.

LESSON 1.—The first lesson should be a discussion of the November farm calendars. Is all of the fall work completed? Have the shortening of the days and cold weather affected farm activities to any extent? Make plans for a December calendar.

LESSONS 2 AND 3.—Horses. Have an informal discussion of the various horses in the neighborhood. How valuable are they on the farm? Do you think all the horses in the neighborhood are the same kind or breed? State some of the differences as to size, shape, color that you have noticed. These differences indicate to some extent the difference in breed, although the ordinary farm horse is rather a mixture of breeds than a distinct one. There are at least three different breeds of horses known, the draft horse, the coach or carriage horse, and the roadster or trotter. The draft horse is heavy, has rather short, heavy legs, a short thick neck and broad deep chest and shoulders. There are several breeds of draft horses. The one most common in Illinois, and, in fact, in the Middle West is the Percheron. This breed came originally from France. Most of the horses are gray, many a beautiful mottled or iron gray. A great many of our common gray horses are part Percheron. Some Percherons, however, are black or dark brown. In England the carriage horse is a distinct breed and is known as the coach horse. In the eastern part of the United States we find more attention given to the coach or true carriage horse than here in the Middle West. This horse is somewhat smaller than the draft, has a long arched neck, and is usually of graceful appearance. The third breed, the roadster, is a slender, tall horse, with long head and neck, rather thin and light. Are there any horses in the neighborhood that are pure-bred roadsters, any that are draft, or carriage horses?

LESSON 4.—Observe the different horses in the neighborhood and note whether any of them seem to come up to the description of these various breeds. Look in the farm papers and magazines for pictures of horses of different kinds and start a chart of these as you did of the different breeds of cattle. What are the uses of the draft horses? (The largest draft horses are used in large cities to draw immense loads of various kinds.) Do you know how much a heavy draft horse weighs? (The heaviest draft horses weigh over 2,000 pounds, medium drafts from 1,600 to 1,700 pounds, and light draft 1,500 to 1,600 pounds.) Do these horses move rapidly or slowly? What is the use of the roadster? The name of course suggests the use. This horse must be able to travel rapidly and endure the strain of travel for a long

time. Why should a roadster be much lighter in weight than a draft or work horse? Do you know of any true carriage horses in your neighborhood? How do they compare with the heavy work horses and the roadsters?

LESSON 5.—Make a list of all the different kinds of work that a farm horse does. Is there any work done by horses that used to be done by man? Inquire of your parents in regard to this matter. Perhaps some of them will remember when corn was planted by hand and all small grain sown broadcast by hand. Have gasoline, or steam engines in any way taken the place of horse power in your neighborhood? (Mention threshers, shellers, automobiles, etc.) (While you do not remember, your parents will, that not many years ago all threshing machines and shellers were run by horse power.)

LESSONS 6 AND 7.—Care of Horses. One of the first things to consider in caring for a horse is its food. Make a list of the various foods eaten by horses. List the various kinds of hay used in the neighborhood. How many are feeding timothy alone? Clover alone? Timothy and clover mixed? Alfalfa? Straw? Who feed oats? Who corn? Does hay contain as much food as the grains. (You remember in your study of physiology that two very important classes of foods are carbohydrates and proteids.) Grains contain a high percent of carbohydrates and not much proteid. You may remember, also, that carbohydrates produce fat and heat. Do you think of any good reason why more foods containing carbohydrates should be fed to horses in winter than in summer? Which kind of food should we feed to animals that we are trying to fatten? Do you feed your working horses on exactly the same kind of food as horses that are running in the pasture or standing in the stable? Why do working horses need a different kind of food and different amounts than idle horses? (When a horse is working he is using up muscle just as boys do when they exercise. Therefore a working horse should be fed more foods than contain proteids because these foods help to build up muscle). Do you feed your horses regularly? When do you feed them? How many times each day? Is it of any importance to observe regularity in the feeding of horses? Why? Horses more than any other kind of domestic animal seem to like order and regularity in their feeding. They seem to know when feeding time has arrived and become nervous if they are not fed. If you expect a horse to keep in a healthy condition you must see to it that he gets his meals at regular times each day. When should a working horse be given its heaviest meal? (The heavy meal should be given at night after the day's work is done. There is a good reason for this. The stomach of the horse is small compared with that of other large animals, hence when horses are fed in the evening they have plenty of time to chew and digest their feed.) A rule given us by those who have made a careful study of the horse is:—For a working horse feed one-fourth the daily ration in the morning, one hour before going to work, one-fourth at noon, and one-half in the evening.

Do you observe the same care in watering your horses as you do in feeding them? Most experts agree that horses should be watered before meals rather than afterwards, the only exception being, perhaps, with the morning meal. What precaution should be taken about watering horses when they are very warm? Many a good horse has been ruined, sometimes killed, by allowing it to drink a large quantity of water when it was very warm.

LESSON 8.—There should be a discussion of some other points to consider in caring for horses. Let the children suggest points worth while. No doubt they will suggest among others, currying and rubbing. When should this be done? How many are in the habit of currying and rubbing horses in the evening after the harness is removed? How many do this only in the morning? How many both evening and morning? The last is by far the best plan. Can you think of a good reason for currying and rubbing horses in the evening? Someone has said that the horses will rest so much better when this is done that he will really be worth more as a worker the next day. What part of the horses requires the most cleaning and rubbing? (The legs should have the most attention although they are often slighted.) Horses whose legs are carefully cleaned are not so liable to develop diseases that many horses are subject to.

Another thing to consider is blanketing the horse in winter. This should be done especially when he has been traveling some distance and is warm and perspiring.

THE HARNESS.—LESSON 9.—What is the purpose of the harness? By discussion the children will probably bring out the facts that harness has two purposes.

One is to enable the horse to do its work and the other to enable the driver to control the horse. Have the boys name all the parts of the harness they know. What parts of the harness help the horse in pulling a load? (The horse uses its shoulders most in moving a load, hence the collar, hames, and traces are of the most service in helping it to move the load in any direction.) What part of the harness enables the driver to control the horse? (The bridle, bit, and lines.)

Can you name the parts of the horse that are likely to be injured by poorly fitting harness. (If a collar fits poorly it is likely to result in a sore neck or shoulder. If the bridle and bits are not right, a sore mouth will result. A crupper that does not fit properly may result in a sore tail. If a horse is used for riding, care should be taken to see that the saddle fits properly, otherwise it may result in a sore back.) Spend some time in discussing how harness should be cared for in order that it may be kept in good condition so that it may not become hard and stiff. (It should, of course, be thoroughly cleansed and occasionally oiled.)

LESSON 10.—It may be well to have the boys name all the different parts of the horse that they know, such as the poll, withers, knee joint, fetlock joint, etc. A good picture, showing parts of the horse may be found in almost any book on agriculture.

What are some of the different steps that horses take? Among others will be named trotting, galloping, pacing, walking, and running.

TRAINING HORSES.—LESSON 11.—One lesson may well be given to the discussion of how horses are trained and broken for use. How many of the boys have ever had anything to do with the breaking of colts? There are a few points that should always be remembered in the training of horses. The most important is that horses have a remarkable memory. They rarely forget a trick or anything that they have once encountered. If they become frightened at a piece of paper in the road and run away they will be very likely to be frightened again the next time they see a piece of paper. For this reason it is very important that horses should be trained carefully so that they may have nothing to remember that will be an injury either to themselves or their owner. A person in breaking a horse, therefore, should be firm yet kind and quiet. Horses should be trained to stand still while being harnessed. They should be taught from the first to stop when the signal "whoa" is given, to move backward, when the signal "back" is given, etc. A horse properly trained will not start forward until he is given the word or signal to start. Have you ever seen horses that began to move the moment the driver took the lines in his hand instead of waiting to be told to go?

Every farm boy should learn how to manage a horse and do it right. If possible have the pupils at this time read and discuss the article by Dean Davenport entitled "Some Points of Good Horsemanship." This is found in a little book entitled "Twelve Studies of Farm Animals," published by Parker, of Taylorville.

LESSON 12.—One lesson should be given to the history of the horse. This may be found in any good cyclopedia. It is also found in the little book suggested in the last lesson. The children should at least know that horses have been known since the beginning of written history. Our ancestors then in pre-historic times must have tamed the wild horse. Horses were probably used at first by these people in hunting other animals that run rapidly. The horse is among the fleetest runners known among animals. The horse in America was brought from Europe. In Europe there are at least two distinct types of horses. A heavy horse that was found in England in the western part of the continent, the other is the Arabian horse that was brought into Europe at the time of the Crusades. The wild horses that we read about in America were horses that escaped from the early Spanish explorers and roamed over the prairies until they became wild.

LESSON 13.—Let this lesson be a summary of the study of the horse. First list all the different breeds; Second, enumerate all the points to be considered in caring for horses; Third, list all the different kinds of work that the horse does.

LESSON 14.—SWINE. Informal discussion of pigs raised in the neighborhood. How many keep pigs? What is the greatest number usually kept by one farmer? What is the purpose of keeping them? How are the hogs housed on the different farms? Look in farm journals for pictures and descriptions of some of the modern approved hog houses. What are the hogs fed? Who are feeding hogs in connection

with cattle? Who are feeding hogs alone for the purpose of fattening them for market? Estimate about how much corn one hog eats in a day, a week, a month. Leave this to be reported after the boys have had an opportunity to make some careful observations of the exact amount fed during a day or week.

Discuss the habits and nature of hogs. How do they drink? Eat? What different things will they eat? How do they differ from horses and cattle in this respect? What kind of noses have they? How does the snout help them to procure food? How deep can a pig dig into the ground to procure roots, grub, worms, etc.? Are pigs easily tamed? Did you ever have a pet pig? Did it show any fondness for you? Did it learn to know you? Do you think pigs show as much intelligence as other domestic animals? Name some things you have seen them do that show intelligence.

Do pigs deserve the reputation that they like dirt and filth? If you give hogs a chance to be clean you will find that they like clean orderly quarters quite as much as other animals do. Do you know why they have probably formed the habit of wallowing in the mud during hot weather? They do not perspire as horses do and so they must keep themselves cool by getting into water.

LESSON 15.—How many different breeds of hogs are represented in the district? How do the different kinds differ from each other in color? Do you know what the common breeds of black hogs are? (The Poland China and Berkshire are both black with some white spots. The Poland China has drooping ears while the Berkshire has erect ears.)

Of the white hogs the Chester White is the most common in the Middle West. It sometimes has blue or black spots on the skin under the hair. The ears are drooping. The Victoria White is somewhat similar but has erect ears.

The common red hog is the Duroc Jersey. It seems to be gaining favor in many parts of Illinois.

Another breed is the Hampshire. This hog is of medium size. It is black with some white. Usually the white is a band around the middle of the body. In some places this hog is becoming a favorite because of the high quality of the meat.

All hogs are grouped into two great classes. These are the lard or fat hogs and bacon hogs. The fat hog has a thick, deep body, strong hams, short head, and short legs. All of the breeds named above are of the fat hog type. The bacon hog is not as broad as the fat hog. It has longer sides, lighter hams, and longer legs. Throughout the corn belt the fat hog type is raised almost exclusively. Farther north some of the bacon types are raised. The bacon type is more common in some parts of the east and in Canada than the fat hog. Collect pictures of different breeds of hogs.

LESSON 16.—HISTORY AND VALUE.—One lesson may be given to the discussion of the history of the domesticated pig. It seems evident that pigs were first domesticated in Asia. Our pigs of today probably originated from the wild hogs of Europe and of Asia. Our American breeds were brought to this country from England. However, different food and climate with the care of breeders have produced a type of hog that differs in its characteristics from the original English breeds.

Have you read of the wild razor back of the South? These are probably hogs that were brought here by the early settlers. They roamed about through the woods feeding upon nuts, roots and other things. Some of them became lost from their owners and roamed about caring for themselves?

How valuable are hogs to the average farmer? Does it pay better to feed corn to pigs or to sell the corn? How are hogs sold, as individuals or by weight? What is a good average weight of hogs ready for market? At about what age are pigs fattened and sold? How many hogs does it take to make a carload?

LESSONS 17 AND 18.—SHEEP.—How many farmers in the community keep sheep? What breeds are represented? Ask at home for information on this.

In most parts of Illinois the Shropshire is the favorite breed. What is the chief purpose of raising sheep? Sheep are raised for mutton and for the wool. At present in America more attention is given to producing sheep for mutton than for wool. How many farmers sell most of their lambs in the fall when they are five or six months old? That is a common practice in many parts of the state?

How are sheep cared for during the summer? The winter? What do sheep eat? Do they crop the grass any closer than horses or cattle do? They eat many weeds that other animals do not touch. Have you known of farmers turning a flock of sheep into a field for the purpose of destroying some noxious weeds? Sheep will

also eat various kinds of twigs and small shrubs. It is often said that sheep can live and thrive in a place where other animals would starve to death.

Some time may well be given to the description of the great sheep ranches in the far west. Sometimes there are several thousand sheep in one flock. In the summer the herders with their faithful shepherd dogs take the flocks to the mountains and hill sides. Here the sheep pasture on the plants which grow in these high altitudes. In the winter the flocks are brought down to the valleys and ravines and feed there.

Let some one in the class describe how sheep are sheared. How many pounds of wool are obtained from one sheep? (This varies with the breeds and size of the sheep. Merinoes often yield from twelve to twenty pounds.) Some sheep do not yield more than eight pounds.

The story of how the wool is prepared for our use in clothing is an interesting one, especially for the girls.

HISTORY.—Sheep have been known since the beginning of written history. In Egypt and Asia people kept sheep in very early times. The domestic sheep probably originated from the wild sheep of Asia and Europe. It is the belief that European breeds of sheep have for their ancestors a small wild sheep that inhabits the Isles of Crete and Cypress and the mountains of Greece. Our American sheep have been introduced from Europe. All members of sheep tribes lived originally in the mountains and highlands. They still retain their love for climbing into almost inaccessible heights. They like also cool climate, high lands, and open ranges. They can not stand to be housed for any length of time.

Look in your farm journals for articles on sheep and sheep raising.

SANITARY STUDIES.—Since much of the work suggested here has already been done in the study of the water supply, of fungi and bacteria, and the care of milk, it is suggested one lesson be devoted to a review of what has already been studied in connection with these topics.

LESSON 19.—What are bacteria? The children should realize that bacteria are small living organisms which are really one-celled plants. These multiply by what is known as cell division, that is one small cell divides into two. Each of these divide again and so on, until in a short time a great number of bacteria have been produced from one cell. The children should realize also that all bacteria are not harmful. When we come to the study of soil we shall find that we are largely dependent upon bacteria for the fertility of the soil. There are useful bacteria also about the homes in the production of some of our foods. Then there is another class of bacteria that may be considered as neither harmful nor useful. The class in which we are most interested in these lessons, however, are those that cause human diseases. How do bacteria cause diseases? Bacteria or germs are taken into our bodies in some way and there they grow and begin to multiply rapidly. In this process of growth they produce poisons in the body which are called toxins. It is these poisons that cause sickness. Make a list of all the diseases that you know that are caused by germs or bacteria. (Tuberculosis or consumption, diphtheria, scarlet fever, typhoid fever, tonsilitis, lockjaw, pneumonia, and colds.) An important point to remember is that none of these diseases can exist unless the germs are carried from some person who is ill with a disease to another person. Since this is true it shows what great care should be exercised in nursing and caring for the sick. Everything then that is used about a sick room should be carefully disinfected before it in any way comes in contact with a well person.

LESSON 20.—What do we mean by disinfectants? A disinfectant is something used for the purpose of killing dangerous bacteria. There are some simple disinfectants that anyone may use. Carbolic acid is one. This should be made into a weak solution which means about three and one-half ounces of carbolic acid to a gallon of water. Clothes and vessels used in a sick room should be washed with this solution. The burning of sulphur candles in a room is a fairly good disinfectant for most disease germs. Of course the sulphur must be burned when there is no one in the room since human beings cannot stand to breathe the fumes of sulphur. Formaldehyde is used most commonly now in disinfecting buildings or rooms. Especial directions are necessary if this work is done properly. In a great many places school buildings are disinfected at least once a month. Can you see why this is done?

LESSON 21.—Besides the use of disinfectants there are other ways to prevent the spread of disease germs. Many bacteria do not like light, in fact they are unable

to live very long in a bright sunlight. Why then should we see to it that sunlight is admitted to all of our rooms, if possible every day.

Hot water kills almost all disease germs. It should be used freely then in washing dishes, clothing, etc., brought from a sick room.

Look around the school room to see if it is in as sanitary a condition as you can make it. Are there piles of dust in the corners? Have the walls been painted or papered recently? Are there fly specks on the windows? Is there dust in the cracks of the floor? Is the water pail uncovered?

JANUARY

OUTLINE FOR JANUARY.—*Simple tools and machinery; levers; uses and advantages of jackscrews, pulleys, etc.*

Machines used in preparing the soil for planting; kinds of plows; harrows; different kinds used in the neighborhood. Cost of different kinds. Evolution of machinery.

Machines used in cultivating crops. Machines used in harvesting crops. Care of machinery, housing, cleaning, oiling; have children report on where machines are kept at their own homes. Gasoline engine and its uses.

LESSON 8.—FARM MACHINERY.—Have the class make a list of the different kinds of machines used on the farm and about the home. Group them as follows: (1) a list of machines used in the preparation of soil for planting of various crops. (2) Machines used in planting the various crops. (3) Machines used in cultivating the crop. (4) Those used in harvesting the crop. (5) Machines used about the barn to make work easier. (6) Machines used in the home.

LESSON 9.—Discuss the value of machinery in general. Why do we use machines? A machine helps us to do the greatest possible amount of work at the least cost. It saves time and labor. A farmer must decide what machinery will pay him best. The machinery that will help him most to reduce the cost of producing his crop is the kind that he wants. A good illustration of how improvement in machinery reduces the cost of production is given in the Cyclopedia of American Agriculture. "In 1830 it required three hours of labor to raise one bushel of wheat. In 1896 it required but ten minutes. In 1850 the labor represented in a bushel of corn was four and one-half hours while in 1894 it had been reduced to forty-one minutes.

LESSON 10.—In the preparation of soil for planting what is the most important implement? What kinds of plows are used in the district? What are the main parts of a plow? (handles, beam, mold-board, share, slip-point.)

The evolution of the plow is interesting. The first plow was a crooked stick that scratched the surface of the ground. Then came the plow with the wooden mold board and iron and steel shares, then the cast iron plow followed by the all-steel plow. Now we have the riding sulky, the gang, and disc plows. Ask your fathers to tell you how many more acres of ground a man can plow now in one day than could be done when they were boys. On some of the large ranches in the west large gang plows drawn by traction engines can plow from 40 to 60 acres per day.

LESSON 11.—Discuss harrows in much the same way as you did plows in the last lesson. Discuss the different kinds of harrows in the district. What is the use of the harrow? Its main use is to smooth and pulverize the soil after it has been plowed. It also helps to kill the first crop of young weeds. Harrows, like plows, have had an interesting history. Little by little they have been improved to make them more effective. At first they were all wood. Then the frame was made of wood and the teeth of iron. Now most harrows are made entirely of steel.

LESSON 12.—What machines are used in sowing oats, wheat, and other small grains? How many have drills? How wide a space will a drill plant at once? How far apart are the drills? What special arrangement has your drill for covering the seeds? Describe the broad cast seeders used in the neighborhood. Ask your father to tell you how grain was formerly sown broadcast by hand.

How is corn planted? Ask your parents to tell you about the evolution of the corn planter. First corn was planted by hand and covered with a hoe. Then a small hand dropper was invented that did not prove very successful. The first corn planter required two persons to work it, one to drive the horses and the other to

drop the corn. The latter person sat on a seat near the front of the planter and pulled a lever or handle back and forth. Finally the present form of planter with the check row was invented.

LESSON 13.—Name the various machines used in cultivating crops. What different kinds of cultivators are represented in the district? These, like plows, have been much improved. Your father can tell you of a time when the single shovel cultivator, drawn by one horse was used.

LESSON 14.—*Harvesting machines.*—Name machines used in harvesting small grains. The evolution of the harvesting machine is most interesting. First the sickle was used; then the scythe and cradle; then the mowing machine, followed by the self-rake reaper, and finally the self-binder and the bundle carrier. Ask your parents to tell you of a time when a number of men worked all day in the wheat and oats fields binding the sheaves by hand and shocking them. The same work can now be done by two men in much less time.

If time permits discuss in a similar manner the machinery used in making and stacking hay.

LESSON 15.—Name all the parts of the threshing outfit. What special work does each part do. How many men are required to do the work? How many bushels of oats or wheat are threshed in a day? Ask at home about the way the threshing machine has been gradually improved.

LESSON 16.—Name and discuss the value of the labor saving machines that are used in the home; cream separators, washing machines, sewing machines, churns, etc.

LESSON 17.—*Machine power.*—All machines must have power in order to do their work. Name the various kinds of power used to run machinery on the farm; human power; horse power; steam power; wind in running wind mills, and the expansive force of gasoline gas in the gasoline engine. Name all the uses of the gasoline engines on the farm. Who knows what makes the gasoline engine run? As you know gasoline changes into vapor or gas quickly even at the ordinary temperature of the room. The engine is so arranged that an electric spark sets on fire a small quantity of the gasoline vapor or gas. Do you know what happens to any gas when it is heated? It expands, occupies a larger space. When the gas from the gasoline expands in the cylinder of the engine it pushes on the piston and as the piston moves outward it turns the fly wheel. This burning or explosion of the gas occurs often enough to keep th eengine running.

It will be of interest to show how one kind of power on the farm has gradually taken the place of other kinds. Can you name some kinds of work that were done years ago by human power, later by horse power, and now by steam or gasoline gas?

Most of the wonderful progress in the improvement of farm machinery has taken place within the last fifty years. Most of the parents of the children will be able to tell interesting stories of the changes and improvement of farm machinery. Send to large implement stores for catalogues showing various kinds of modern machines.

LESSON 18.—*Care of machinery.*—Have the children report where the different machines are kept during the season when they are not in use. Why should they be kept under shelter? What happens to iron or steel when left out in the moist air? (Just why they rust we shall learn by some experiments in February.) All bright parts of machines should be thoroughly oiled or greased before the machine is put away. Before a machine is taken out to be used what should be done? It should be gone over very carefully to see that all bolts are tight and every part in good repair. It is simply following the old adage, "A stitch in time saves nine."

Some one has estimated the length of time certain machines should last if they are well cared for. The average life of plows, harrows, binders and mowers should be from twelve to fifteen years; of drills, seeders, cultivators, from ten to twenty years.

How many have simple tool shops somewhere about the place? It is an excellent thing for a boy to have a tool shop and to learn how to use various tools. He should have hammers, saw, wrenches, squares, brace and mit, bolts; nuts, etc. A farmer can often save much time and money by making simple repairs on his own farm implements.

SIMPLE MACHINES.—The boys and girls will be interested to know that all of the machines that we have discussed are constructed with reference to certain

fundamental physical laws. They will know more about those laws when they study physics in the high school. For the present, however, they should know that there are only six simple machines and that all farm machinery simply shows various combinations and modification of these. The six simple machines are: The lever, the pulley, wheel and axle, the inclined plane, the wedge, and the screw.

The simplest lever is a long bar of wood or metal that works on a point or pivot. When you pry up a walk or a stove with a stick or crowbar you are using a lever. A common pump handle is a lever. Can you think of other simple levers about the home.

Have you ever seen a simple pulley with a rope over it and a weight on one end? Can you think of a farm machine that illustrates the pulley? The hay derrick is a good illustration. Name all the machines you can think of in which a wheel and axles are used. The screw is almost as common as the wheel in machinery. Have you ever seen a house lifted on jack screws? All bolts are screws. The wedge and inclined plane are not as common as the other simple machines. The straw carrier in the threshing machine is a good illustration of the inclined plane.

FEBRUARY

OUTLINE FOR FEBRUARY.—*Food storage in seeds and other parts of plants. Food in the potato; in corn kernel; simple test for starch and oil. Other materials found in plants, proteids, sugar, fiber and cellulose. Raw materials that plants use in making their foods; sources. Some idea of an element, a chemical compound, an acid, alkali. Elements needed by plants. Elements commonly lacking in the soil. Some ways of supplying these elements.*

For these lessons a few simple pieces of apparatus are necessary. Many of these may be furnished by the pupils. A few glass tumblers, some iron nails or tacks, a little powdered sulphur, a small bottle of lime water, some baking soda, ten cents' worth of tincture of iodine, a few wide-mouthed bottles, vaseline or pickle bottles will do. A small alcohol lamp will aid in the experiment.

The purpose of these lessons on plant products is to lead pupils to discover the various substances found in plants and to prepare them for the lessons on soil which follow.

LESSON 1.—Have the pupil scrape as fine as possible one or two potatoes. Place the scrapings in a tumbler of water, stir thoroughly two or three times, and set aside to settle. Examine next day. What do you find in the bottom of the tumbler? Drain off all the water and potato pulp, leaving nothing but the starchy looking mass in the bottom. Boil some water over the alcohol lamp and pour a little of this into the tumbler, stirring until the starch thickens. This resembles ordinary starch used for clothes. There is a chemical test, however, that will prove beyond any doubt that this is starch. Place a small quantity of the cooked starch on a plate or saucer, and then put two or three drops of iodine on it. Tincture of iodine that may be bought at any drug store will serve the purpose. This may be diluted with water. What is the effect of iodine on this substance? The blue color indicates the presence of starch. The darker the blue the more starch there is present. Sometimes it is almost black. Place a drop of iodine on a slice of raw potato. Does it show as much starch as that which was cooked? The reason the latter shows more starch is that the boiling water causes the walls of the starch granules to burst open and the iodine can act more readily upon the starch.

LESSON 2.—Pour a little boiling water over some flour and test it for starch; over cornmeal, oatmeal, cornstarch, etc.

LESSONS 3 AND 4.—Soak some grains of corn for forty-eight hours, or half an hour in hot water. Each pupil should have at least two grains. At the pointed end of the grain find the tip cap. Remove this. With a knife or pin remove the hull. You will see that the grain under the hull is covered with a thin smooth material that with care may be scraped off with a knife. This is called horny gluten. Now dig out the germ or embryo. This is the dirty white oval shaped portion that fills up the groove in the soaked grain. Split open the remaining part of the grain. How many kinds of material are left? Place the white granular material found near the top of the grain in a pile. Add to it the same kind of material found near the tip. Put the hard, solid looking substance in another pile. You now have six different substances found in your grain of corn. Test each of these with iodine as you did your potato starch and flour. It is better to crush them as much as possible before putting

on the hot water. What part shows the most starch? It is probable that the soft granular part will turn the darkest blue. This part is known as crown starch. The solid hard part, if thoroughly boiled, will show some starch. This is called horny starch. What parts do not contain the starch? This means, of course, that there must be some substance other than starch in the grain of corn.

LESSON 5.—Remove some fresh embryoes from soaked grains and crush them on a sheet of white writing paper. Hold the paper between you and the light. What does this show? The grease spot indicates the presence of oil or fat. Test other seeds in this way for oil, such as sunflower, squash, pumpkin, flaxseed, etc. Have the pupils put a small pinch of each of the following on a sheet of paper: flour, cornmeal, any cereal breakfast food, buckwheat, and ground coffee. Place the sheet in a hot oven and keep it there several minutes. Now see whether the paper shows that any of these things contain oil. Have the pupils name some plants whose seeds contain so much oil that it is extracted and used for various commercial purposes. (Flax, cotton, castor oil bean.)

LESSON 6.—Besides starch and oil plants contain other substances known as proteids. In your physiology you may have learned of albumen as a kind of proteid. One of the purest types of proteid known is the white of egg. Another substance in plants is sugar. Why does a sweet potato taste sweeter than the common white potato? Name other plants that have sugar in them. From what plants is the sugar of commerce obtained? All starch found in plants is changed into sugar before it can be absorbed by plants or animals for starch is insoluble in water, and all substances absorbed by living bodies must be dissolved in water.

Is there any part of your corn grain that does not seem to have any of these substances named above? The hulls are made up mostly of a substance called cellulose. Cellulose is found in all plants, and is the material that gives strength and firmness to the different parts. It is found in the cell walls, in fibers of stems, roots, and leaves, as well as in fruits and seeds. It is harder and thicker in some parts of plants than in others, as in stems, husk, and roots. The fibers of cotton, hemp, and flax are made chiefly of cellulose. Soak some common newspaper or writing paper in water till all the sizing is washed out. The pulp which remains is almost pure cellulose. Do you know what most of our paper is made from? (From wood, that is from the cellulose of the woody stems of trees.)

Where do the plants get all these substances? A discussion of this question will bring out the fact that plants manufacture them. All plants that have green leaves or the green coloring matter in the young stems make starch, sugar and the other things that you found in corn, potatoes, etc. They may, therefore, be called plant products or plant foods. It will add interest to the work to have pupils make a collection of the plant products. These should be put into bottles and carefully labeled. The following are the products most available for this purpose:

Starch—from corn or potatoes.
Sugar—ordinary cane sugar, or maple sugar.
Oil—linseed, cottonseed, corn oil.
Proteids—beans, peas, corn embryo.
Fiber—cotton, flax.
Cellulose—stems or hulls of corn, paper pulp.

LESSONS 7 AND 8.—We have said in Lesson 6 that plants manufacture certain plant products. Now if plants are factories what equipment must they have? Machinery, power, and raw material out of which to make the starch, sugar, etc. What is the source of this raw material?

By discussion it may be brought out that the environment of the plant is air, soil, and soil water; hence these are the only available sources from which the plants may obtain raw materials to make their plant products.

Just how the plants procure the raw material, and how they make the foods, we shall take up for consideration in some later lessons. At present we are concerned chiefly in finding out what the materials are that the plants use in making foods and plant tissues.

We know that we cannot find starch as starch in the air or water or soil. We also know that starch is made up of several substances which are united to form what we call a chemical compound.

What is a chemical compound?

What is a good example of a chemical compound? It is formed by the union of two things, oxygen and hydrogen. Both of these are invisible gases. Do either of

them resemble water? They do not, yet chemists can separate water into these two gases. No one, however, can separate either oxygen or hydrogen into other substances so we call these elements.

What then is an element? It is a substance that so far as chemists know cannot be separated into other substances. There are only between seventy and eighty elements known. Everything else in the world is in the form of a compound. How are compounds formed? By the chemical union of two or more elements. Just to mix the elements together will not necessarily make a compound. They must unite in definite proportions. In order to know what we mean by this you must know that everything in the world is made up of very small particles called molecules. The molecules are so small that they cannot be seen by the most powerful microscope. Each molecule is made up of still smaller particles called atoms. Now when a chemical union takes place a certain number of atoms of one element unite with a certain number of atoms of another element or elements and make a molecule of a new substance which is a compound. We know that water is a chemical compound made by the union of hydrogen and oxygen. Two atoms of hydrogen unite with one atom of oxygen to make water, hence we use the symbol H^2O to stand for water.

Chemical unions are taking place constantly in the world of nature. The following experiment will show us one of these unions.

EXPERIMENT.—Moisten a piece of iron (nails or tacks); place the wet iron on a piece of paper exposed to the air. Examine the next day. What has happened? A chemical combination has taken place between the iron and the oxygen in the air. In common terms we call this rust. It is iron oxide, or if hydrogen has also combined with the iron and oxygen, which is probable, it is iron hydroxide. What happens to iron of any sort when left exposed to air?

LESSON 9.—Another simple experiment to show a chemical combination may be performed. Place a small piece of sulphur on a bright silver coin and set the sulphur on fire. You can do that by putting a live coal on the sulphur. When it has burned look at the coin. What has taken place? The dark substance is silver sulphide. A chemical combination has taken place between the sulphur and the silver. Was all the sulphur used in making the silver sulphide? What did you see taking place above the coin? Was anything uniting with the sulphur to form the blue flame or smoke? The oxygen of the air. The compound is sulphur dioxide. It is a gas and escaped into the air. How did you know it was in the air? You probably noticed the sulphur odor in the air.

Now in plants chemical combinations take place which result in the plant products we have found. Starch is a combination of oxygen, hydrogen and carbon. The symbols for these are O. H. and C respectively. Proteid is a combination of carbon, hydrogen, and oxygen, with nitrogen, sulphur, phosphorus, and often other elements.

LESSON 10.—Where does the plant get the oxygen that it uses in making starch? It probably gets it as well as the hydrogen, from the water which it gets out of the soil. What must first be done with the water? The plant must separate the water into its elements, oxygen and hydrogen.

Where does the plant get the carbon? This is obtained from the air. How do we know that plants contain carbon? Place a small piece of wood (hard wood is best) on a piece of wire screen, or on a tin pie plate, or in a test tube. Heat by holding the flame of a lamp under it or by holding it on a shovel over a bed of hot coals in the stove. When it stops smoking note what is left. The charcoal is mostly carbon. What is its color? Think of other plants which you have seen heated or partially burned, such as leaves, grass, cornstalks, brush. Do you remember seeing any charcoal or carbon?

We said the plant gets its carbon out of the air. Do you think it gets it in the form in which you see the carbon in the charcoal? It gets it in the form of a gas called carbon dioxide, C, O^2. Is this gas an element or a compound? How do you know? We know it is a compound for the symbol says it is made of two elements. We may make some carbon dioxide in the following manner: Place a heaping teaspoonful of soda in a glass half full of water and add to this a few teaspoonfuls of vinegar. Stir and see what happens. This gas that bubbles up is carbon dioxide. What does C O^2 tell you about a molecule of gas? C says one atom of carbon and O^2 says two atoms of oxygen. Test for carbon dioxide with lime water. Carbon dioxide turns lime water milky. Lime water may be made by placing a piece of unslaked lime in a bottle, and filling the bottle nearly full of water. Shake well, and set aside for twenty-four hours. The clear water on top is lime water.

LESSONS 11 AND 12.—We have already discussed three elements that plants use in manufacturing food. What are the other things that are needed? The following is a list of elements that plants need: Oxygen, hydrogen, carbon, nitrogen, sulphur, phosphorus, iron, magnesium, potassium (usually in the form of potash) calcium. All plants must have all ten of these elements if they live and grow.

We have seen that the first three elements named above are supplied to the plant from the water and air. Where do the plants get all the rest? These are obtained from the soil.

How many of the things furnished the plants by the soil may be found as elements in the soil? If not, then in what form must they exist? All of them exist in the soil as compounds.

The compounds that exist in the soil may be acids, alkalies, or salts.

Can you think of some things about the home that are acids? (They are substances that are sour, such as vinegar, sour milk, hydrochloric acid, sulphuric acid, etc.

Alkalies are substances like lye and potash. Baking soda and lime are alkalies.

If you mix together an alkali and an acid one so acts upon the other that the characteristics of both are destroyed. Put a few tablespoonfuls of strong vinegar into a cup or glass half full of water. Taste it. Now put a teaspoonful of soda into the sour water. After it stops foaming taste it. Is it as sour as it was before? We say the soda has neutralized the acid.

A salt is neither alkali nor acid. Common table salt is a good example of this kind of compound.

Some soils contain more acids than are good for plants. If we put an alkali of some kind into sour soil we may sweeten it. Do you know any substance that some farmers put on the soil for this purpose? (Lime is frequently used to sweeten soil.)

LESSON 13.—It will be worth while to have the children make a collection of as many of the elements and compounds used by plants as they can get—such as iron, sulphur, lime which has calcium in it, salt peter which contain nitrogen, burnt bones which contain phosphorus, epsom salts containing magnesium. These should be put into small bottles and carefully labeled.

Some time should be taken at this point for the discussion of what is meant by fertility of the soil. Of the ten elements that all plants must have, seven are supplied by the soil. Name these seven. Where do the plants get oxygen, hydrogen, and carbon? If any of the elements supplied by the soil are lacking or are not in an available form, we say the soil is poor, or lacking in fertility. There are many physical conditions also that help to make the soil fertile. These will be discussed in a later lesson. But all the proper physical conditions known will not make a fertile soil if it lacks any of the elements that plants must have in order to manufacture their plant products.

LESSONS 14 AND 15.—Most of the substances used by plants exist in such abundance in the soil that there is little danger of their becoming exhausted. Three elements, however, that all farm crops use are not so abundant. These are phosphorus, potassium, and nitrogen. In some places calcium also is lacking. If fields are cultivated year after year the plants are constantly removing these substances from the soil. If nothing is done to return these substances of course the soil becomes so deficient in these plant materials that plants cannot thrive in it. It is very important that farmers see to it that the lack is supplied in some way.

There are several ways in which the soil may be kept with a sufficient amount of plant material. Among these are the application of barn manures, the plowing under of green crops especially clovers and the use of commercial fertilizers.

Among the commercial fertilizers, the following are in common use:

For nitrogen dried blood is used. This contains twelve to fourteen per cent of nitrogen. Sodium nitrate is also used, and this contains about fifteen per cent nitrogen.

For phosphorus, steamed bone is used, which contains about twelve or fourteen per cent of phosphorus. Rock phosphate is also used.

For potassium or potash, potassium chloride is used, which has forty to forty-two per cent of potassium. Kainit, which contains twelve per cent of potassium, is also used. Potassium carbonate in the form of wood ashes is also used wherever this available.

Lime is used as a fertilizer either in form of gypsum, quicklime, or slaked lime. While most soils have enough lime to supply the needs of the plants, lime is, neverthe-

less, of considerable value to any soil that has become acid, as we have already seen. It also helps to unlock the unavailable potash, phosphorus, and nitrogen in some soils and changes them to a form available for plant use. Why do soils become sour?

There are a number of agencies that tend to make soils sour, especially soils that are constantly undergoing cultivation. In our study of fungi we discussed the bacteria that cause organic matter in the soil to decay. Now as this matter decays, acids of various kinds are given off. Another acid in the soil is carbon dioxide, some of which is carried into the soil by the rain. Sulphuric and nitric acids are also found in soils. Some of the nitric acid is formed in the following way: When stable manure is plowed into the soil certain bacteria feed upon it, making it decay, and at the same time making part of it into ammonia. Other bacteria feed upon the ammonia, making part of it into nitric acid. Some of this acid remains in the soil, but some of it unites with the potassium or magnesium and forms nitrates. It is in the form of these nitrates that plants obtain the nitrogen from the soil.

From our study of clover and other legumes we know that nitrogen may be also supplied by growing these plants that produce root tubercles.

If possible add to your collection samples of the commercial fertilizers.

MARCH

OUTLINE FOR MARCH.—Review origin and kinds of soil. Simple experiments in soil physics; review source of water in the soil; movements of water; forms in which water exists in the soil; value of draining off free water; capillarity; power of different kinds of soil to absorb water. Method of retaining the moisture in the soil. Simple experiments showing value of soil mulch; air in soil; parts of plant concerned in getting water from the soil. Experiments to show transpiration. Need of light and warmth.

Oats. Test samples of seed for purity and vitality. Methods of planting. Treat seeds with formalin for smut. Different varieties raised on neighborhood. History of oats. Uses.

LESSONS 1 AND 2.—Review origin of soil, different types of soil. (Sand, silt, clay, humus, loam. See Lessons 6 and 8 for November in the sixth year.)

LESSONS 3 AND 4.—Review experiments showing what becomes of the water that soaks into the ground after rains. (These are found in Lessons 12 and 13 for November in the sixth year.) Be sure that the children have a clear notion of what we mean *free water* which fills the spaces between the particles of soil, and *capillary water* which clings to the soil particles and makes it moist. They must remember also that it is capillary water that plants use.

LESSONS 5 AND 6.—Repeat the experiment suggested in Lesson 15 of November, sixth year. The problems to be solved here are, what kind of soils have the greatest capacity to hold rain water, which drains most readily, and which is most porous. To determine which has the greatest capacity measure carefully the amount of water put in and the amount that drips away. This experiment cannot be finished in one day. It will take several days for the water to get through the clay or silt.

LESSON 7.—Is there any water left in the soil after the free water has all dripped out? What becomes of this capillary water? To answer this perform the following experiment:

Fill a tumbler with moist soil. Over it invert another tumbler the same size. Set it aside. Examine after twenty-four hours. What do you find on the inverted tumbler? Where did the moisture come from? What may be done to prevent the evaporation of water from the soil? Again, place moist soil in the tumbler. Put on top a layer of very dry, fine soil, one inch deep. Invert a tumbler over this as before, and note whether or not any evaporation takes place. If the moisture in the top layer of soil evaporates, does this in any way affect the moisture farther down in the soil?

Fill the lamp chimneys once more with the different kinds of dry soil. Stand them in a dish or pan of water so that the mouth over which the cheese cloth is tied will rest about half an inch in the water. What happens? What makes the water creep upward in the soils?

Hang a towel over a desk so that about an inch of the corner will rest in a dish of water on the floor. What takes place? The same thing is happening in the

towel and in the soil. The water is slowly rising. This is due to what is known as capillarity or capillary attraction. To explain fully why this takes place would take us too far into the subject of physics. It is enough for us to know that liquids rise long distances through small tubes or pores. We have a good illustration of this in the ordinary lamp wick which conveys oil from the bowl of the lamp to the top of the wick.

LESSON 8.—In which kind of soil does the water rise most rapidly? In which does it reach the greatest height? If a field has an abundance of water in the subsoil this may be lifted by capillarity to the place where it will be of use to the growing plant. Watch the rise of the water in the soil for several days. Vary the experiment by mixing humus with clay in one chimney and with sand in another. Put lumpy loam in one and fine loam in another. The last experiments show the value of having soil in good physical condition if we expect the capillary water to be carried upward to the roots of the plants.

LESSON 9.—Think of all the ways in which the water brought by capillarity to the surface of the ground in a corn field is used up. Part of it is taken up by the roots and part evaporates. If the sun is very warm a vast amount of water evaporates and is lost to the plants. Is there anything that may be done to prevent this loss of moisture during the dry, summer months? We saw that a layer of fine dry soil has on the moist soil in the tumblers retarded evaporation. Now place in two tin pans or pails (lard or syrup pails will serve the purpose) equal amounts of moist soil. Firm the soil slightly by jarring the pails. Set them side by side. Leave one undisturbed, but in the other stir thoroughly the upper two inches of soil every day. Weigh at the end of a week. Which has retained more moisture? Why? By stirring the soil the capillary tubes are broken, the water does not come to the surface, and cannot evaporate. Which will keep the more moisture, a field in which the soil is frequently stirred on top with a cultivator or one which is left undisturbed?

Place a lump of sugar so that the lower part will rest in some red or black ink. Does the ink rise by capillarity to the top of the sugar? Place another lump beside this one with a layer of granulated sugar sprinkled over the top. Does the ink rise as rapidly through the loose sugar as through the lump? Why?

In the same way, as long as the soil is left alone, the water is constantly moving by capillarity to the surface and evaporating. A layer of dry, pulverized soil on top stops the capillary flow of water and moisture is conserved for the use of the plants. We call this layer of dry soil on top a soil mulch. It pays to cultivate the corn fields during dry weather just to keep a soil mulch on the field even if there are no weeds to destroy.

LESSON 10.—When the soil is loose on top and there is no free water in it do you think there is anything in the spaces between the soil particles? To answer this question we shall try a simple experiment. Fill a tumbler or cup full of dry soil, pour water in one spot, watch for bubbles of air that the water drives out. Keep on pouring in water until all the air is out. Do you see what has happened? The water has taken the place of the air that was in the spaces. In all the soil of the fields the spaces are filled with air. When the water fills these spaces what happens? Have you ever seen a corn or oats field on which water has stood for several days? We say they are "drowned out." That is because all the air has been cut off by the water from the roots.

LESSON 11. OATS.—Discuss the value of the oats crop in the neighborhood. How many in the district raise oats? How much do they raise? Who are going to plant oats this spring? What was raised on the ground last year? Are oats to be sown alone or with clover? What kind of oats are raised in the district? Ask each child to bring a small sample of oats for study next day.

LESSON 12.—Study of the grain. Note the chaffy covering. Remove it. Notice the size, shape, and color. Compare the different varieties in regard to these points. Make a comparative study with grains of wheat and rye if this can be done.

Test the samples for purity. To do this have the pupils spread a small handful of oats on white paper. Look closely for foreign bodies of any sort. Are there any weed seeds? Can you identify these? Put all the weed seeds and trash into one pile and all the oats in another. About what part of your sample is pure oats?

LESSON 12.—You want your seed oats to germinate. You can not tell by looking at the sample whether they have this power or not. You must make a

germination test. Take from the sample one hundred seeds. Place some moist sand or soil in a dinner plate or box. Scatter the seeds over the sand, not allowing any of them to touch each other. Press each seed gently into the sand so that it will rest firmly but not be covered. Turn another plate over this one or cover it up with a damp cloth and set in a warm place. Be sure to keep the sand moist.

Watch for germination. How long after planting before the first sprout appears? Allow the grains to remain at least one day after germination begins, then remove the sprouted grains daily till all have sprouted that will. By counting the grains that are left you will be able to determine the percent that germinated. If you do not wish to take the time remove the sprouted grain each day, allow the plate to stand three or four days after the grains have begun to sprout, then remove those that have failed to germinate and compute your per cent of germination as before. Did all the grains show equal vigor of germination? Would you expect to get a good stand of oats from seed whose germination test was not higher than sixty or seventy per cent?

LESSON 13. PLANTING.—Discuss with the children the different methods of sowing oats. Who in the district sows broadcast? How many drill oats? Is there any advantage of one method over another? Encourage the children to watch to see whether one method seems better than the other. What is the proper time for planting? A good rule is to sow as early in the spring as the soil is dry enough to work well. Discuss the number of bushels it takes to sow an acre. You will probably find differences of opinion in regard to this. The average, however, is from three to three and one-half bushels per acre. Some recent experiments seem to show that most farmers plant their oats entirely too thick and that planting one or one and one-half bushels per acre will give a better yield than planting in the ordinary way. How deep are oats planted? Is there any danger of planting too deeply? An experiment may be tried. Place in a mason jar an inch of soil and plant close to the glass on one side a grain of oats and one or two on the other side. Put another inch of soil in and then two or three more seeds close to the glass, and so on until the jar is filled within an inch of the top. Keep watered and watch to see whether the seeds planted near the surface germinate and grow any better than those planted near the bottom of the jar.

LESSON 14.—Has any member of the class ever seen any smut on oats? This is a common disease of the oats that entirely spoils the head. The seed may be treated for this disease before planting and growth of smut almost entirely prevented. Encourage some of the pupils to try treating the seed and planting on their home farms. Make a weak solution of formalin, one tablespoonful to a gallon of water. Put the seed into a gunny sack and allow it to remain in the solution ten minutes. Spread it out on the floor to dry and plant it as soon as dry.

LESSON 15.—History and uses of oats. Oats originally belonged to a cold climate. It is one of the greatest crops in northern regions; in Sweden and northern Russia, as well as in the northern parts of our own country. Some of the best varieties originated in Sweden and Russia. It is for this reason that we may plant oats so very early in the spring. Have the children watch the oats to see whether the frost injures it. Have them name all the uses of oats; for feeding, the value in the rotation of crops, the uses of the straw. Are oats used at all for human food? In some countries oats constitute one of the staple foods in the making of bread as well as porridge.

LESSON 16.—Watch the development of the plant. Plant a little spot in the school yard, or all the observations may be made at home. How long after planting till the oats appear above the ground? How low a temperature can these young plants stand? Note the habits of growth. Does one root send up more than one stem? Count the number of stems that you find coming from one root.

APRIL AND MAY

OUTLINE FOR APRIL AND MAY.—The work of plants. Simple experiments to show the relation of roots to soil, work of stem, work of leaves.

Methods used in maintaining fertility of soils of Illinois; rotation of crops; manures; fertilizers; cultivation. Report on neighborhood practice. Work of the U. S. Department of Agriculture. State experiment stations; send for bulletins.

The work of plants. Simple experiments to show the relation of roots to soil, work of stem, work of leaves.

Girls study how to arrange flowers of gardens at home and school. List of vegetables that may be raised in home garden. Select one or two for special study.

Arrange vacation studies and experiments.

NOTE.—In preparation for the lessons later in the month plant in cans, flower pots, or boxes some corn, oats, radishes, peas or nasturtiums. When the oats are about two inches high cover one-half as suggested in Lesson 9 of this month.

LESSON 1.—Review the various products that plants make; starch, sugar, proteid, etc. (See February lessons.) Try to have the children think of plants not only as living but as working beings. They are like factories since they manufacture products. If they are factories what equipment must they have? (Machinery, raw material, and power.) We have already learned that the raw material is supplied from the air, the soil, and the soil water. We are now ready to find out how the plants do their work.

LESSONS 2 AND 3.—Experiment. Put some moist blotting paper or sand on a damp cloth in a dinner plate or box. Scatter over this at some distance apart a number of radish or oats seeds. Turn another plate or piece of cloth over this to keep in the moisture, and put in a warm place. Water if necessary. At the same time plant a few seeds in a pot or can of soil. After three or four days examine the plants. What do you find on the roots? Those delicate threadlike structures are root hairs. On what part of the roots do you find them most abundant? Watch a plant for several days to see whether any of the hairs wither and die, and whether new ones continue to appear. Are there any at the very tip of the root? Can you see any advantage in not having root hairs here? (As the root grows it must penetrate the soil. If there were hairs on the tip they would be broken off.) What do you think is the use of the root hairs? If the little plants were growing in the soil instead of on blotting paper the root hairs would penetrate the spaces between the particles of soil. Pull up one or two of the little plants that are growing in the pot. Do any of the soil particles cling to the roots? They are really clinging to the root hairs. Of course in pulling up the young plants you pulled off most of the delicate hairs. These hairs are in close contact with the film water on the soil particles. They are so surrounded with this moisture that they absorb it; that is, the moisture goes right through the thin covering of the root hair. We call the process by which liquids or gases pass through a plant or animal membrane osmosis. The walls of the root hairs are very thin and by osmosis the soil water with the plant materials passes readily through them. At the same time a little of the thicker substance in the root hairs passes out into the soil.

LESSON 3.—Roots are so much in need of water to do their work that they will grow rapidly in the direction of moisture. You may prove that roots seek moisture by a very simple experiment. Trim a little off the side of a chalk box lid so you may push it down into the box, making a partition through the middle. Near the bottom of this partition cut or bore a hole as large as a half dollar, and tack a piece of wire screening over it. Place clean sand or soil in the box, and plant corn or oats on one side. After the seeds have germinated, put a very little water on the side of the partition where the plants are growing; just enough to keep them alive. Keep the other side will moistened but not wet. After two weeks, carefully dig down and examine the roots. If your experiment has worked properly you will find that the roots of the plants have grown through the wire screen in order to get to the moisture.

LESSON 4.—If a field is not well drained the young plants in the spring will not send their roots very far down into the soil. An experiment will help to show this. Procure two tin cans. In the bottom of one punch holes for drainage and put in a few pebbles or cinders. Leave the other without drainage. Fill each with moist soil and plant corn or beans or oats. Set them side by side. Place exactly the same amount of water in each from day to day. Do not water too much. After a few weeks dig up the plants and note the effect on the roots. Which have sent their roots farthest down? Does under drainage tend to make a long or short root system? The children will readily see that a long root system is an advantage to any farm crop. Which plants will fare better during the dry season, those whose roots have grown to a good depth or those whose roots are near the surface?

LESSON 5.—We have seen that thrugh the root hairs the soil water with raw materials goes into the roots. Where does this water go, and what finally becomes of it? Experiment. Cut off a growing twig from a maple, or box-elder. Place the cut stem in a tumbler half full of water to which you have added a teaspoonful of red ink. Allow it to stand twenty-four hours. With a sharp knife slice off small sections of the stem and examine closely. Through what part of the stem did the water travel? This is called the woody part or wood. In all tree and shrub stems the water travels upward through the wood. In stems of herbs like beans there is very little wood. What there is is in small bundles around the pith. The water travels upward through these bundles. In a corn stem the water travels upward through the bundles of fibers that are scattered throughout the pith.

LESSON 6.—Is all the water taken into the plant used in the plant? Experiment. Cover with glazed or writing paper the top of a pot in which a plant is growing vigorously. To do this slit the paper to the center and cut out a space big enough for the stem. Now slip the paper around the stem and tie it around the top of the pot. Turn a glass jar over the plant and let it stand in the light a few hours. What do you find on the glass? Where did the drops of water come from? This process of giving off water is called transpiration. The leaves transpire constantly. With a microscope we could find very numerous pores in the thin skin of a leaf. These are called stomates. The water goes in at the roots, travels up the stem into the leaves, and most of it is given off into the air through the stomates.

LESSONS 7 AND 8.—We are now ready to find out something about the way in which plants manufacture their products. To understand this we must know something about leaves.

Examine a leaf of any plant. The stem is the petiole, the expanded part is the blade. Hold the leaf between you and the light. What do you see in it? How are the veins arranged in a bean leaf, maple, sunflower? These are net-veined leaves. How are the veins arranged in a corn leaf? In grass? These are parallel veins. What is the use of the veins? By discussion the value of the veins in holding the leaf spread out will be brought out. Place a twig with growing leaves in a tumbler of water colored with red ink. After twenty-four hours examine the petiole and the veins. The red ink in the veins tells you that the veins carry water to all parts of the leaf. If you can procure a thick leaf, as live-forever, tulip, or hepatica, have the pupils peel off a little of the skin or epidermis. Even a thin leaf may have a little of the covering removed, enough to lead the pupils to see that the entire leaf is covered with a thin, almost transparent skin. What is under the skin? This green granular mass is largely made up of a substance called chlorophyll. If the pupil could see a cross section of a leaf highly magnified he would find it built up of cells. Each cell has a thin wall and contains green, roundish bodies called chlorophyll bodies, and a moss of colorless protoplasm. These form the machinery that manufacture plant food. But just as any machinery must have power to make it run, so must the machinery of the leaf. What is the power?

LESSON 9.—Experiment: Fill a box or dinner plate with soil and sow some oats or wheat seeds. After the grains are sprouted cover one-half the plants with a box or tin can. Give all the plants the same amount of water. After a week compare the plants grown under cover with those grown in the light. What do the former lack? What is your conclusion as to the ability of the plants to make chlorophyll without light? Recall the color of grass that has been covered with a board. What is the color of potato sprouts in a cellar? Without light, plants cannot make chlorophyll, and without chlorophyll no starch can be made. The light is the power that runs the machinery, but the chlorophyll is the connecting link between the power and the machine. In some way is succeeds in hitching them together so that they may do their work.

LESSON 10.—We remember that starch is made out of oxygen and hydrogen from water and carbon from air, and that proteids contain these three elements with the addition of nitrogen, sulphur, phosphorus, etc., which come from the soil.

The leaves take in the carbon dioxide through their stomates. What must be done with this compound before the plant can use the carbon? It must be separated into its elements, oxygen and carbon. If the protoplasm decomposes the carbon dioxide and uses the carbon, what becomes of the oxygen? It goes out of the leaf into the air. Therefore, when a plant is actively engaged in manufacturing starch it is

taking carbon dioxide from the air and giving out oxygen. Why cannot this process be carried on during the night?

LESSON 11.—What do the plants do with the starch, proteids, and oils that they make? The starch, by a process something like digestion in our bodies, is changed into sugar, and this and the other foods are conveyed in liquid form from the leaves to all parts of the plants. They are used in the growth of these parts.

Do plants grow at night? Measure some of your corn plants at night and again in the morning to see how much they grow. While plants cannot make food at night, they can use the food that they have made during the daylight for growth during the darkness. Some of the food is stored for future use. Recall the study of the potato, corn seeds, biennial roots, etc.

Dig up some corn plants that have been growing two or three weeks. Examine the grains. What has become of their contents?

LESSON 12.—Plants need something besides food in order to live and grow. They are like animals in this respect. They must have air to breathe as well as food to eat. They cannot live without oxygen any more than you can. Not only the leaves but the stems and roots also need oxygen. They carry on respiration just as we do, that is, they use the oxygen in the cells and give out carbon dioxide as a waste product.

Have the pupils summarize all the work of the plants. What the roots do, the stems, and the leaves.

LESSON 13. HOW TO MAINTAIN THE FERTILITY OF THE SOIL.—Now that we know something about the needs of plants and the work they do we are ready to consider what may be done not only to produce good crops but to insure the production of good crops in the future.

One thing to be considered is tillage. This is of two kinds: the breaking up or plowing preparation for the seed, and the cultivation of the soil when the crop is growing. The plowing may be done in the fall or spring. Can you think of any advantage of fall plowing? What effect has freezing upon the soil? There may be some disadvantages in fall plowing in some localities. Where there is a subsoil of sand, heavy rains may wash out or leach from the soil some of the soluble compounds that with the spring plowing might have been saved for the plants. One of the most important things to think about in tillage is the preparation of the seed bed, so that it may be fine and fit for seeds.

Experiment: Plant some corn seeds in a pot containing coarse, lumpy soil. In another plant seeds containing the same kind of soil that has been made fine. Water both. In which do the seeds germinate first? Which plants thrive best after germination?

What are some of the other benefits due to tillage? It increases the depth of the soil. Which is better, shallow plowing or deep? Why? If year after year only the upper three or four inches of soil are turned over, this will become so depleted of its plant foods that it will be "worn out." Besides the lower layer of soil will become so packed and sour that it will be utterly unfit for the plant roots. Tillage also aids in the saving of moisture. How? Think back to your experiment with soil mulch. It also loosens the soil so that it will hold more air and be better ventilated. It kills out the weeds and thus prevents a loss of plant foods and water. By breaking up the soil particles it renders the plant foods more available. It turns under vegetation and thus increases the amount of humus in the soil.

LESSON 14.—The second thing to consider in helping the soil to supply the needs of plants is drainage. We have already seen some of the advantages of under drainage. It renders the soil more porous. In increases the temperature in the spring. It gives an opportunity for better ventilation. It results in a deeper root system. Proper tillage and drainage then are two very important forces in maintaining good physical conditions of the soil.

The rotation of crops is another important consideration. Agriculturists are coming to believe more and more that to grow the same kind of crop in a field near after year will result in absolute ruin to the soil. There are several reasons for this. One is that certain kinds of crops use more of the kind of plant material than of others. After a number of years the soil is so lacking in this particular compound that it is difficult to grow any kind of a crop in it. Another probable reason is that each plant gives out a certain amount of organic waste matter into the soil. When

a plant has been grown for a term of years in one locality, the soil becomes so full of this poisonous waste that the plant can no longer thrive in it. This substance is not so poisonous to other plants and by a wise rotation of crops this waste need not result in disadvantage to the plants. Rotation also gives an opportunity to kill out weeds that are likely to persist if the same crop is grown year after year. It also helps to get rid of certain insect pests. Every farmer must settle for himself the crops that are to be rotated; but he should adopt a definite system of plant rotation. A three-year rotation is carried on successfully in some places. This consists of oats, or wheat, clover, corn. Have the class tell what is practiced in their neighborhood.

LESSONS 15 AND 16.—One important result that comes with crop rotation is the increase of humus. Humus is added in the plowing under of the oats or wheat stubble, as well as the stems and roots of the clover. The value of humus in any soil cannot be overestimated. From our experiments what do you know of the effect of humus on the capacity of soils to hold moisture? It helps to keep the moisture in. Besides, this humus improves the texture of the soil, enriches it, and helps to make available to plants other materials that are locked up in the soil.

What are the sources of humus? We have already mentioned the plowing under of stubble and clover. What substance necessary for plants does the clover and other legumes add to the soil? (Nitrogen.) Other crops besides legumes are sometimes raised and plowed under for the purpose of supplying humus. Such crops are called green manures. Rye is frequently used in this way. Stable manure is by far the best source of humus. It not only improves the physical condition in the soil but adds some of the most important substances which plants use, phosphorus, nitrogen, and potassium. It is the most perfect of all fertilizers.

One thing more is done in many places to keep up the fertility of the soil, and that is the use of commercial fertilizers. This we have already discussed in our study of soil chemistry. Just what plant materials may be lacking in any soil can be told only by testing the soil, not in the laboratory but in the field. Some very interesting experiments have been made by the Agricultural College at Urbana to show the value of commercial fertilizers.

To sum up the whole story then. In order to increase the fertility of the soil we must see to it that the soil is kept in good physical condition by proper tillage, drainage, and the addition of humus, and that the plant materials that are removed by the plants to manufacture their food be returned in good measure in the form of stable manures, leguminous plants, green manures, or commercial fertilizers.

LESSON 17. FARM NOTES.—It will be worth while to take one recitation to discuss the activities on the farm for the school year, using the calendars that have been kept. Encourage the boys to continue the calendar during the summer.

LESSON 18. THE GARDEN.—Encourage the girls to plant flower gardens at home. Consult catalogues for kinds to plant. Discuss methods of planting and arranging flowers as suggested in the lessons for the sixth year.

Encourage the boys to plant corn or oats for a contest in the fall. If corn is to be grown each boy should plant at least one-eighth of an acre.

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